PHYSICS ABSTRACTS

SECTION A

of

SCIENCE ABSTRACTS

SECTION A, PHYSICS

SECTION B, ELECTRICAL ENGINEERING

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RELATED SUBJECTS CONTAINED IN SECTION B (ELECTRICAL ENGINEERING ABSTRACTS)

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Corrosion
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Electronic relays and counters
Automatic control mechanisms
Applied electrochemistry
Photocells
Thermionic tubes
Cathode-ray tubes
X-ray tubes
Induction accelerators
Cyclotrons
Amplifiers
Radio-wave propagation
Mechanical engineering
Heat engines
Illumination
Metallurgy

NOTE ON THE ARRANGEMENT OF ABSTRACTS

The Abstracts are classified by subject according to the Universal Decimal Classification, and arranged in order of their U.D.C. numbers, which are printed at the head of the Abstract on the left. Abstracts on any particular subject can be located by first consulting the abridged tables of the U.D.C. published with the January number, or the Annual Alphabetical Subject Index, and then referring to the appropriate U.D.C. number in the text. The main headings are listed above.

An Abstract of interest under more than one head has additional U.D.C. numbers, linked by the colon sign, " : " e.g. "536.21 : 548.0 Conduction of heat in crystals." The Abstract is printed once only, under the main number, e.g. in the section "HEAT 536," but Cross-references are inserted under the other numbers, e.g. "548.0 : 536.21 *see Abstr.* 1234" in the section "CRYSTALLOGRAPHY 548." These Cross-references should be investigated, therefore, when a particular section is being searched, as they contain additional matter relevant to that section. A Cross-reference does *not* refer to the Abstract which appears immediately above it.

[*Continued on page* 3 *of cover*

MATHEMATICS 51

512.3 502

Tables of Chebyshev polynomials. JONES, C. W., MILLER, J. C. P., CONN, J. F. C., AND PANKHURST, R. C. *Proc. Roy. Soc. Edinb. A*, **62** (*Pt II*) 188–203 (1946).

512.3 503

Two numerical applications of Chebyshev polynomials. MILLER, J. C. P. *Proc. Roy. Soc. Edinb. A*, **62** (*Pt II*) 204–10 (1946).

513.8 504

On lattice points in n-dimensional star bodies. I. Existence theorems. MAHLER, K. *Proc. Roy. Soc. A*, **187**, 151–87 (*Oct.* 22, 1946).

517.512 505

Contributions to the problem of approximation of equidistant data by analytic functions. Part B. On the problem of osculatory interpolation. A second class of analytic approximation formulae. SCHOENBERG, I. J. *Quart. Appl. Math.*, **4**, 112–41 (*July*, 1946).—A continuation of previous work [Abstr. 2008 (1946)]. Various analytical properties of the cosine polynomials and some related sets of polynomials are considered, and some ordinary polynomial interpolation formulae of the Jenkins–Greville type are constructed. Two classes of smoothing interpolation formulae are derived, and some analytic interpolation formulae of basic functions which dampen out like $\exp(-c^2x^2)$ are set up. An example of smoothing is given, and some tables are appended for use in numerical applications. L. S. G.

517.521.7 506

A note on a particular type of asymptotic series. RANKIN, R. A. *Phil. Mag.*, **36**, 860–1 (*Dec.*, 1945).—The useful range of application of a general class of asymptotic formulae is extended by obtaining narrower bands for the error term than those usually employed. The results apply to a function, $f(x)$, which possesses an alternating asymptotic series and is of the form $f(x) = \int_0^\infty (1+t)^{-1}\phi(t, x)dt$. L. S. G.

517.564.3 : 517.6 = 4 *see Abstr.* 507

517.6 : 517.564.3 = 4 507

Series and definite integrals containing Bessel functions. I–VI. RUTGERS, J. G. *Proc. Ned. Akad. Wet.*, **44** (*No.* 4) 464–74; (*No.* 5) 636–47; (*No.* 6) 744–53; (*No.* 7) 840–51; (*No.* 8) 978–88; (*No.* 9) 1092–8 (1941) *In French.*—Large numbers of definite integrals are evaluated, in series form, by applications of the result,

$$I_{\nu+\rho+1}(x)/(\rho+1) = \int_0^x I_\nu(x-a)I_{\rho+1}(a)a^{-1}da$$

ν and ρ being such that their real parts > -1; e.g. the series, $2\Sigma(-)^nI_{2n+1}(x) = \sin x$ leads to

$$2\Sigma(-)^nI_{\rho+2n+2}(x) = (\rho+1)\int_0^x I_{\rho+1}(\alpha)\sin(x-\alpha)x^{-1}d\alpha$$

where the summation is from $n = 0$ to $n = \infty$. L. S. G.

517.944 : 536.2 508

A practical method for numerical evaluation of solutions of partial differential equations of the heat-conduction type. CRANK, J., AND NICOLSON, P. *Proc. Camb. Phil. Soc.*, **43**, 50–67 (*Jan.*, 1947).—The non-linear equation studied is

$$\partial\theta/\partial t = \partial^2\theta/\partial x^2 - q\partial w/\partial t$$

where $\partial w/\partial t = -kwe^{-A/\theta}$, and the boundary conditions are: (1) $\theta = f_1(x)$, $w = f_2(x)$, at $t = 0$ for $0 < x < 1$; (2) $\partial\theta/\partial x = H_1(\theta)$ at $x = 0$ for $t \geqslant 0$; (3) $\partial\theta/\partial x = H_2(\theta)$ at $x = 1$ for $t \geqslant 0$. The application of Hartree's 2 methods [Abstr. 3403 B (1937), 608 (1947)] is discussed. The differential analyser was used to obtain solutions, and mechanical difficulties are examined. A numerical method was also developed. In this, both derivatives are replaced by finite difference ratios, and an iterative process, like a relaxation method, was devised. Detailed results in 2 special cases are examined. [See Abstr. 2112 (1946)]. L. S. G.

518.2 509

Four-figure tables of the Airy function in the complex plane. WOODWARD, P. M., AND WOODWARD, A. M. *Phil. Mag.*, **37**, 236–61 (*April*, 1946).

518.5 : 621.317.39 510

The automatic sequence controlled calculator. I. AIKEN, H. H., AND HOPPER, G. M. *Elect. Engng, N.Y.*, **65**, 384–91 (*Aug.–Sept.*); 449–54 (*Oct.*); 522–8 (*Nov.*, 1946).—A short history of mechanical calculating machines is followed by a description of a new electro-magnetic device for carrying out 5 fundamental operations—addition, subtraction, multiplication, division, and reference to computed tables such as logarithm and trigonometrical. The basic design is a switchboard comprising separate panels for different functions, including 60 constant registers, 72 adding-storage registers, a central multiplying and dividing unit and electro-mechanical tables of the functions $\log_{10} x$, 10^x, and $\sin x$. The whole is governed by an automatic sequence mechanism. Normal operation is to 23 significant digits, and 3 interpolator units operate at any order up to the 11th. Computed results may be recorded on tabulating machine cards for further computation, or may be printed on an electric typewriter. Operation time varies from 0·3 sec to 1 min or more. E. H. W. B.

519.2 511

A problem in the summation of simple harmonic functions of the same amplitude and frequency but of random phase. HORNER, F. *Phil. Mag.*, **37**, 145–62 (*March*, 1946).

519.241.6 : 53.088.3 *see Abstr.* 519

519.27 512

Choice of a "reality index" for suspected cyclic variations. GLEISSBERG, W. *Nature, Lond.*, **158**, 915–16 (*Dec.* 21, 1946).

ASTRONOMY . ASTROPHYSICS . GEODESY 52

523.2 513

Angular momentum of the solar system. TER HAAR, D. *Nature, Lond.*, **158**, 874 (*Dec.* 14, 1946).

523.531 : 621.396.96 514

Radar detection of meteor trails. APPLETON, E., AND NAISMITH, R. *Nature, Lond.*, **158**, 936–7 (*Dec.* 28, 1946).—A portion of the records made on the night of Oct. 9–10, 1946, of random echoes on 27 Mc/s presented on a c.r.o. and recorded photographically, is shown. The echoes showed a sharp peak at about 3.30 G.M.T. and the time-distribution curve is markedly similar to that from visual observations of a previous Giacobinid shower. None of the echoes came from lower than 90 km above the ground.

523.72 515

Origin of radio emissions from the disturbed sun. MARTYN, D. F. *Nature, Lond.*, **159**, 26–7 (*Jan.* 4, 1947).—The suggestion is made that the abnormal emission associated with sunspots comes from oscillating electron gases [Abstr. 2433 (1931)] in the magnetic field of the spot. The "ordinary" mode is absorbed by the overlying layers, but the "extra-ordinary" mode will escape; this explains the observed polarization. The energy for maintaining the oscillations could come from the breakdown of polarization on the side walls of the sunspots [see Abstr. 2301 (1945)].

523.72 : 621.396.821 516

Solar radiation at 480 Mc/sec. REBER, G. *Nature, Lond.*, **158**, 945 (*Dec.* 28, 1946).—The normal intensity was measured to be about 5×10^{-19} W/cm² per Mc/s, corresponding to a solar temperature of 10^6 °C. During a magnetic storm, greatly increased intensity was observed, up to 400× normal for several minutes at a time, with occasional bursts up to several thousand ×, which had a swishing sound in telephones unlike ordinary noise. The latter were also observed, though fainter, with the aerial directed at right angles to the sun, and also at night. The possibly originated in the atmosphere by the passage of charged particles.

523.75 : 537.591.5 *see Abstr.* 644

523.813 : 523.842 *see Abstr.* 518

523.83 51

Statistical hypotheses in stellar dynamics. JEHLE, H. *Phys. Rev.*, **70**, 538–55 (*Oct.* 1 *and* 15, 1946).—The following hypothesis is examined as a possible basis for stellar dynamics: The minimum volume of the Boltzmann phase space (position and momentum) of a stellar system, in which one may expect to find an element of the system, is σ^3 where $\sigma = \sigma_0 M$, M being the total mass of the system and σ_0 a universal constant of the order of G/c. The mass distribution function has therefore a limited determinacy and there is an expected minimum distance between statistically independent elements. The continuity equation in position space and the Bernouilli equation are transformable into a wave-equation of Schrödinger type, which is much simpler than the original hydrodynamical equations, under the conditions found in stellar systems. G. C. McV.

523.842 : 523.813 = 4 518

On large parallaxes and slow moving double stars. BELORIZKY, D. *C.R. Acad. Sci., Paris*, **222**, 863–4 (*April* 8, 1946) *In French.*—This note gives results of an examination of the catalogued parallaxes of slow moving double stars and suggests criteria for selecting pairs for observation which are likely to yield large parallaxes. E. G. M.

525.37 : 591.5 : 591.185.63 *see Abstr.* 710

53.081.4 : 548.73 : 537.531 *see Abstr.* 635

53.081.6 : 530.14 *see Abstr.* 527

PHYSICS 53

53.088.3 : 519.241.6 519

Experimental data and "sufficient" accuracy. CARRIER, N. H. *Nature, Lond.*, **159**, 167 (*Feb.* 1, 1947).—[See Abstr. 2249 (1946)].

FUNDAMENTALS 530.1

530.12 520

Metric of space and the equations of motion of a charged particle. MOSHARRAFA, A. M. *Math. Phys. Soc. Egypt, Proc.*, **3**, 19–24 (*May*, 1945).—The geodesics of a space in which the line-element ds is given in terms of the co-ordinate-differentials by $0 = g_{\mu\nu}dx^\mu dx^\nu + 2f_\mu dx^\mu ds - ds^2$ is worked out. If f^μ is identified with ek^μ/m where e is the charge and m the mass of a particle and k^μ is the electromagnetic potential vector, the geodesic equation is approximately identifiable with the equation of motion of a charged particle in a combined gravitational and electromagnetic field. The null-geodesics are the same as those of the Riemannian space defined by the $g_{\mu\nu}$ alone. The expressions for the length of a vector and for the cosine of the angle between two vectors are worked out for the new space. G. C. McV.

530.12 521

On homogeneous gravitational fields in the general theory of relativity and the clock paradox. MØLLER, C. *K. Danske Vidensk. Selsk. Mat.-fys. Medd.*, **20** (*No.* 19) 25 *pp.* (1943).—Two clocks, C_1 and C_2, move relative to one another in a straight line. C_1 passes C_2, travels a certain distance, has its motion reversed and re-passes C_2. It is required to show that the differences in time registered by the clocks between their first and second coincidences are the same whether the calculation is made with respect to a co-ordinate system in which C_1 is at rest or with respect to one in which C_2 is at rest. It is assumed that C_2 is at rest in a system

(X, Y, Z, T) for which $ds^2 = dX^2 + dY^2 + dZ^2 - dT^2$ whilst C_1 is at rest in a system (x, y, z, t), during the period of the reversal of its motion, for which $ds^2 = dx^2 + dy^2 + dz^2 - (1 + gx)^2 dt^2$. The transformation equations between these co-ordinate systems are set up (for constant g) and the required equality of time-differences proved. G. C. McV.

530.12 = 4 522

On the general structure of a unified theory of the gravitational, electromagnetic and meson fields. TONNELAT, M. A. *C.R. Acad. Sci., Paris*, **222**, 1162–4 (*May* 15, 1946) *In French.*—Schrödinger's unified field theory is modified, first, by not restricting the form of the affine connection at the start and, secondly, by supposing that the Action function depends solely on three simple antisymmetric tensors, which may be derived in a variety of ways, and on the vector Λ_μ. V. C. A. F.

530.12 = 4 523

Special scheme for a unified theory of the gravitational, electromagnetic and meson fields. TONNELAT, M. A. *C.R. Acad. Sci., Paris*, **222**, 1211–15 (*May* 20, 1946) *In French.*—Considers the implications of the special choice of the Action function given in Abstr. 522 (1947)]. V. C. A. F.

530.12 : 530.145.6 *see Abstr.* 532

530.14 524

On a generalization of Dirac's equations. ERIKSSON, H. A. S. *Ark. Mat. Astr. Fys.*, **33 B** (*No.* 2) *Paper* 6, 7 *pp.* (1946).—Dirac's equations are not invariant against unrestricted Lorentz transformations, and a theory is proposed in which such invariance does hold. It involves an appeal to 5- and 6-dimensional space, in which orthogonal matrices are constructed by the Cayley process, and the important Lorentz transformations are obtained by a suitable specialization of the parameters [Abstr. 92 (1945)]. It is hoped that the theory will resolve some difficulties in the meson theory of nuclear forces, and this is briefly discussed. L. S. G.

530.14 525

On the theory of spinning particles. SHANMUGADHASAN, S. *Proc. Camb. Phil. Soc.*, **43**, 106–17 (*Jan.*, 1947).—The classical equations of motion are obtained for a single spinning particle with charge and dipole moment in an electromagnetic field. Symmetry is maintained between the retarded and advanced fields, and between the ingoing and outgoing fields. It is assumed that the spin angular momentum tensor $\theta_{\mu\nu}$ satisfies $\theta^2 \equiv \theta_{\mu\nu}\theta^{\mu\nu} = \text{const.}$, and the value of the dipole moment is chosen to be $C\theta_{\mu\nu}$ ($C = \text{const.}$). The theory is generalized to several particles. The classical equations are put into Hamiltonian form by means of the Wentzel field and the λ-limiting process, and then the passage to the quantum theory is effected. The theory is extended to a generalized wave field, whose potentials, U_ν, in free space satisfy $(\Box + \chi^2)U_\nu = 0$. The Wentzel field is now defined in terms of the generalized relativistic δ-function. L. S. G.

530.14 526

Fundamental particles. PEIERLS, R. *Nature, Lond.*, **158**, 773–5 (*Nov.* 30, 1946).—A short review of the properties and relationships of the eight fundamental particles (including the photon) which are believed at present to exist.

530.14 : 53.081.6 527

On a relation between some natural constants and the lesser particles. STOKES, A. R. *Phil. Mag.*, **37**, 287–8 (*April*, 1946).—[See Abstr. 1499 (1946)].

530.14 = 3 528

On the charge dependence of nuclear forces in the vector meson theory without neutral mesons. JOST, R. *Helv. Phys. Acta*, **19** (*No.* 3) 113–36 (1946) *In German.*—The problem examined is whether the nuclear forces between 2 nucleons in the ^1S-state is, at least approximately, charge-independent in the charged theory. The nucleon model taken is that used previously [Abstr. 983, 985, 1110 (1946)]. Part of the paper is devoted to an approximate method for solving eigenvalue problems. The results are: The charged theory is unsuitable for the representation of nuclear forces assuming strong coupling; and the nuclear forces are charge-independent, to the approximation taken. L. S. G.

530.14 = 4 529

Theory of interaction [liaison] in wave mechanics. DESTOUCHES, J. L. *C.R. Acad. Sci., Paris*, **222**, 48–51 (*Jan.* 2, 1946) *In French.*—Interaction can arise in 6 cases, e.g. in a system admitting a separation of variables, or in a system admitting a first quadratic integral independent of the time. These cases are discussed, and the 2 conditions for interaction are stated. L. S. G.

530.14 = 4 530

Expansors, particular cases and applications. COURTOIS, J. *C.R. Acad. Sci., Paris*, **222**, 864–6 (*April* 8, 1946) *In French.*—A continuation of previous work [Abstr. 2475 (1946)]. Application is now made to the potential energy of a system of particles. In the case of electric charges the proper energy may equal the limit of the mutual energy of 2 neighbouring particles; analytic continuation without singularities is possible. L. S. G.

530.14 = 4 531

Significance of the principle of spectral decomposition. DESTOUCHES-FÉVRIER, P. *C.R. Acad. Sci., Paris*, **222**, 866–8 (*April* 8, 1946) *In French.*—A general discussion of the importance of spectral decomposition in wave-mechanics. Lattice theory, in particular complemented lattices, finds an application. Probabilities are expressed as the kth power of the amplitudes in the decomposition. When $k = 1$ we have the classical theory, and $k = 2$ gives the quantum theory. A "subjective" theory is defined, and in such a theory $k = 2$. L. S. G.

530.145.6 : 530.12 532

Relativistic wave equations. ELIEZER, C. J. *Nature, Lond.*, **159**, 60 (*Jan.* 11, 1947).

GENERAL MECHANICS . MECHANICS OF SOLIDS 531

531.19 = 3 533

Quantum statistics and the problem of He II. SOMMERFELD, A. *Z. Naturforsch.*, **1**, 120 (*March*, 1946) *In German.*—The relation between the proposals

of the author [*Ber. dtsch. chem. Ges.*, **75**, 1988 (1942)] and the papers by Schubert [Abstr. 3068 (1946)] and Wergeland [*K. Norske Vidensk. Selsk. Forh.*, **17**, 51].

G. J. K.

531.224 = 3 534

Critical remarks on the technical bending theory. ZIEGLER, H. *Schweiz. Bauztg*, **128**, 187–91 (*Oct.* 12, 1946) *In German.*—Modifications must be made in classical bending theory to make it applicable to rods with varying cross-section and where the loads are inclined to the axis of the rod, so that tensile, shearing and bending stresses occur in sections perpendicular to the axis. The ratio ε between breadth and length is supposed to be small. The orders of magnitude of the stress components and their derivatives are expressed as powers ε^{-1}, ε^{0}, ε^{1}, ε^{2}, . . . of ε. The axial normal stresses are developed into a power series in ε, and to a first approximation, confined to ε^{-1}, the classical values are obtained. Further approximations furnish the required generalizations.

R. N.

531.258 535

On the state of stress in perforated strips and plates. I–VI. SCHULZ, K. J. *Proc. K. Ned. Akad. Wet.*, **45** (*No.* 3) 233–9; (*No.* 4) 341–6; (*No.* 5) 457–64; (*No.* 6) 524–32 (1942); **48**, 282–300 (1945).—The method utilizes the Airy stress function, and stress functions are found for (1) an infinite plate containing a single circular hole or a row of holes; (2) a semi-infinite plate. In (1) there is a prescribed stress along the edge of the hole and in (2) a prescribed periodic stress along the edge of the plate. Formulae are derived for the stress components at the points of certain lines and these are applied to the following problems: I. A symmetrical strip, with one row of holes, subject to pure tension in the longitudinal direction. II. The same strip subject to uniform flexure. III. A semi-infinite plate with a row of rivet-holes parallel to the edge, the boundary stresses of every hole being such that the resultant force is perpendicular to the edge. Numerical values for the coefficients of the stress functions are given for various ranges of values of the relevant parameters.

L. S. G.

MECHANICAL MEASUREMENTS 531.7

531.714 : 621.317.39 536

Electrical resistance wire strain-gauges to measure large strains. SWAINGER, K. H. *Nature, Lond.*, **159**, 61–2 (*Jan.* 11, 1947).—The linear range can be increased up to 7 or 8% strain by using "Minalpha" wire, and ensuring that the joints to the heavy lead wires are not strained.

531.717 : 621.357.7 537

Determination of the thickness of chromium deposits on nickel by the drop test. SPENCER-TIMMS, E. S. *J. Electrodepos. Tech. Soc.*, **21**, 79–90 (1946).—[Abstr. 723 B (1947)].

531.754.2 538

Determination of the density of a fine powder. RUBY, W. R., AND LOVELAND, R. P. *J. Phys. Chem.*, **50**, 345–63 (*July*, 1946).

MECHANICS OF LIQUIDS 532

532.13 : 539.501 539

Notes on the rate process theory of flow. BONDI, A. *J. Chem. Phys.*, **14**, 591–607 (*Oct.*, 1946).—This paper deals with the separation of the contributing terms of the energy and entropy of activation for viscous flow and the identification of some of the molecular constants entering into these terms, as a step toward the prediction of the viscosity of liquids from first principles.

A.

532.13 : 541.64 540

The intrinsic viscosity of polymer solutions. DEBYE, P. *J. Chem. Phys.*, **14**, 636–9 (*Oct.*, 1946).

532.13 : 541.68 *see Abstr.* 691

532.133 541

Viscosities of pure hydrocarbons. GEIST, J. M., AND CANNON, M. R. *Industr. Engng. Chem.* (*Analyt. Edit.*), **18**, 611–13 (*Oct.*, 1946).—Relative and absolute viscosities at 20°C of 56 hydrocarbons (5 to 10 C atoms) measured with a capillary viscometer, are listed; the former values are accurate to $\pm 0{\cdot}1\%$, the latter to $0{\cdot}5\%$, because of the uncertainty in the absolute value for water used as calibrating fluid.

532.5 542

Relaxation methods applied to engineering problems. XII. Fluid motions characterized by "free streamlines." SOUTHWELL, R. V., AND VAISEY, G. *Philos. Trans.* (*No.* 815) 117–61 (*Nov.* 12, 1946).—In the type of problem dealt with a double condition is imposed at a boundary initially unknown [see Abstr. 1155 (1941)]. The basic theory for laminar and axially symmetric flow is presented and the application of relaxation methods to the equations obtained is discussed. The first set of examples, worked out in detail, relates to jets uninfluenced by gravity, e.g. the Borda mouthpiece in laminar or axially symmetric flow, and an orifice plate in a circular tube. Jets subject to gravitational forces are next studied. The first example is a waterfall (2 free surfaces) and the second is a 2-dimensional planing surface (seaplane). Lastly, examples of free stream lines forming boundaries of waves are discussed. These include the waves behind a circular cylinder and a sphere.

L. S. G.

532.133 : 541.68 543

The dependence of the viscosities of liquids on reduced temperature, and a relation between viscosity, density, and chemical constitution. THOMAS, L. H. *J. Chem. Soc.*, 573–9 (*July*, 1946). *See also Nature, Lond.*, **157**, 622 (*Nov.* 2, 1946).—An exponential equation is proposed representing the variation of the viscosities of liquids with reduced temperature in terms of two constants, one being characteristic of each liquid, and the other being approximately constant for all normal, non-associated liquids. The values of the constants for a large number of liquids are tabulated and the relation between the characteristic constant and molecular constitution is discussed.

532.516 544

"Thermal wedge" theory of the parallel surface thrust bearing. WOOD, W. L., AND CAMERON, A.

Nature, Lond., **159**, 61 (*Jan.* 11, 1947).—[See Abstr. 3078 (1946)].

532.525 : 537.212 *see Abstr.* 624

532.542.1 545

The flow of gases in pipes at low pressures. BROWN, G. P., DINARDO, A., CHENG, G. K., AND SHERWOOD, T. K. *J. Appl. Phys.*, **17**, 802–13 (*Oct.*, 1946).—Data are presented on the flow of air at low pressures in Cu pipes of radius 0·795 and 1·30 cm; Fe pipes of radius 2·64, 5·12, and 10·1 cm; and for H in a Cu pipe of radius 1·30 cm. Data are also given for the resistance to flow of air in 1½ and 3 in nominal pipe size elbows, for 1½ in Kinney bellows valves, and for short sections of 1 in nominal pipe size Fe pipe connecting large gas chambers. The data on straight Fe and Cu pipes, together with the data from the literature on glass capillaries, are correlated by the introduction of a correction factor F in Poiseuille's equation. F is correlated graphically in terms of a dimensionless group representing the ratio of mean free path to pipe radius, with separate curves for Fe pipe and for Cu and glass pipes or capillaries. A.

CAPILLARITY 532.6

532.6 546

Bubble formation from contact of surfaces. HARVEY, E. N., COOPER, K. W., AND WHITELY, A. H. *J. Amer. Chem. Soc.*, **68**, 2119–20 (*Oct.*, 1946).—The formation of bubbles from soda-water on scratching the vessel sides has been investigated, and it has been found that the bubbles form only during the process of chipping the glass. It is considered unlikely that the bubble formation is due to sound waves generated by the scratching. Generation of bubbles from water highly supersaturated with N_2 by rolling a plexiglass sphere over the glass is explained by assuming that when the vessel surface and the sphere surface separate, a dry point is formed which acts as a nucleus for bubble formation. W. R. A.

532.612.4 547

The surface tension of chloroform: its variation with the composition of the gas phase. CUPPLES, H. L. *J. Phys. Chem.*, **50**, 412–17 (*Sept.*, 1946).

532.694.1.08 548

A meter for the measurement of the properties and quantity of foam. CLARK, N. O. *J. Sci. Instrum.*, **23**, 256–9 (*Nov.*, 1946).—A flow meter for foam has been designed which behaves as an absolute instrument with linear velocities up to 5 cm/sec. Above this value calibration is necessary, and extends the range up to at least 100 cm/sec. A combined instrument is described using the helicoid flowmeter principle, together with the electrical conductivity method for expansion and the optical density method for specific surface measurement. A.

KINETIC THEORY OF LIQUIDS 532.7

532.7 : 534.22 : 534.321.9 *see Abstr.* 561

532.7 : 534.321.9 *see Abstr.* 560

532.72.08 549

A new type of diffusion cell. CLAESSON, S. *Nature, Lond.*, **158**, 834–5 (*Dec.* 7, 1946).—A steel cell is described for making diffusion measurements with organic solvents as well as water. Several experiments can be performed consecutively without dismantling if the solvents are the same.

532.74 : 537.226 *see Abstr.* 626

MECHANICS OF GASES 533

533.21 : 534.321.9 = 5 550

On the determination of the adiabatic compressibility of ethylene isomers by means of ultrasonic waves. BACCAREDDA, M., AND GIACOMINI, A. *Ric. Sci. Ricostruz.*, **16**, 611–14 (*May–June*, 1946). *See also Atti. Accad. Naz. Lincei*, **1** (*Nos.* 3–4) 401–8 (1946). *Pubbl. Ist. Naz. Elettroacust. O.M. Corbino* (*No.* 53) 8 *pp.* (1946) *In Italian.*—The method of Abstr. 1665 (1934) was modified in two respects. (1) The stationary waves were produced by two beams of ultrasonic waves propagated in opposite senses and generated by two quartz sheets fed by the same h.f. generator; (2) the waves were observed by high-magnification projection on a screen with suitable cross-lines. The results indicate that the coefficients of compressibility are smaller for *cis*- than for *trans*-compounds. V. C. A. F.

533.275 = 3 551

Aspiration psychrometers. STUCKI, S. I. A. E. *Schweiz. Bauztg.*, **128**, 292–4 (*Dec.* 7, 1946) *In German.*—The Assmann and Haenni aspiration psychrometers are briefly considered and compared, and it is concluded that neither is a really satisfactory instrument. Inaccuracies arise from conduction to or from the thermometers, as a result of the air stream, from inadequate wetting of the wick, etc. Fifteen points to be observed when making humidity measurements include: ample time to reach equilibrium with the ambient temperature; an air-speed of 2–4 m/s; sufficient time for complete wetting of the wick; correct placing relative to surrounding objects; protection from radiation. E. H. D.

533.6.08 : 621.317.39 552

Hot-wire velocity meters. MEHAFFEY, W. R. *Radio-Electronic Engng*, **7**, 11–13, 26 (*Oct.*, 1946).—Hot-wire anemometers suitable for the measurement of velocities of gases or liquids, and for the investigation of turbulence are briefly described. The range of sensitivity is increased by the application of electronics, vacuum-tube current regulators and automatic balancing systems. J. S. G. T.

533.75 : 539.132 *see Abstr.* 655

VIBRATIONS . ACOUSTICS 534

534.01 553

Upper and lower bounds to Rayleigh's frequency for a vibrating system. TAYLOR, W. J. *J. Chem. Phys.*, **14**, 570–1 (*Sept.*, 1946).—A variation method of Weinstein [Abstr. 4444 (1934)] has been applied

to an oscillating system. μ_1, the (frequency)^2 of the system when constrained to oscillate in a given manner, is obtained from the constants of the free system and the assigned amplitudes of its parts. The method then shows that at least one value of μ for the free system lies in the range $\mu_1 \pm (\mu_2 - \mu_1^2)^{\frac{1}{2}}$, where μ_2 is a second quantity which can be calculated. In principle, by variation of the assumed type of motion so that $(\mu_2 - \mu_1^2)$ is a minimum, any of the true frequencies and motions of the free system is obtainable. G. J. K.

534.142 : 545.71 554

An optical-acoustic method of gas analysis. CALLISEN, F. I. *Nature, Lond.*, **159**, 167 (*Feb.* 1, 1947).—Vengerov's method [Abstr. 2285 (1946)] is not new; the "Uras" apparatus, in use for the last 10 years, is described.

534.213 : 550.341 *see Abstr.* 698

534.22 : 532.7 : 534.321.9 *see Abstr.* 561

534.22 : 536.48 *see Abstr.* 613

534.222.2 = 4 555

On the structure of explosive waves in gaseous mixtures. MANSON, N. *C.R. Acad. Sci., Paris*, **222**, 46–8 (*Jan.* 2, 1946) *In French.*—The equation governing the vibrations is solved in terms of Bessel functions and the frequencies of vibration are calculated for several mixtures, e.g. $CO + 0{\cdot}5\,O_2$, $H_2 + 0{\cdot}5\,O_2$, $C_2H_2 + O_2$, $CH_4 + O_2$. Several modes of vibration are possible, and these determine the structure of the wave, including the wave front. L. S. G.

534.231.3 = 5 556

Measurement of acoustic absorption by a stationary wave method. SACERDOTE, G. *Alta Frequenza*, **15**, 68–76 (*June*, 1946) *In Italian.*—Air pressures are measured at several points inside a Kundt's tube, and from their values, using methods analogous to electric line theory, the acoustic characteristic impedance, the reflecting power of the end of the tube, and the energy density can be calculated. A.

534.321.9 = 4 557

On the absorption of ultrasonic waves by carbon disulphide. OUANG, T. T. *C.R. Acad. Sci., Paris*, **222**, 1215–16 (*May* 20, 1946) *In French.*—Measurements have been made at 1·63 Mc/s, using the light diffraction method. The absorption is deduced from the darkening of the central fringe for various positions of the light source with respect to the quartz generator. A comparison is made with results obtained by other observers and the anomalous value of the absorption coefficient is confirmed. G. F. H.

534.321.9 558

Absorption of supersonic waves in liquids. TEETER, C. E., JR. *J. Acoust. Soc. Amer.*, **18**, 488–95 (*Oct.*, 1946).—A brief account is given of a new pulse technique, which is believed to be particularly suitable for absorption measurements. Measurements at 15 mc/s for solutions of inorganic salts, organic liquids, and water at various temperatures, and also at 10 mc/s for water at various temperatures are reported. It is shown that for water, and probably for other substances, the temperature coefficient of absorption may be larger than heretofore supposed, and hence more attention should be paid in the future to the statting of absorption apparatus.

534.321.9 = 5

Ultrasonic velocity in *cis*- and *trans*- deca BACCAREDDA, M. *Ric. Sci. Ricostruz.*, **16**, 6 (*May–June*, 1946) *In Italian.*

534.321.9 : 532.7

Physical basis of a new theory of absorptio ultrasonics in liquids. PARSHAD, R. *Nature, Lo* **158**, 874–5 (*Dec.* 14, 1946).—It is suggested absorption is due to molecular distortion, and absorption of energy into molecular vibrations, the mutual interference of the electron atmosphere colliding molecules. On this basis, the ultraso absorption would be high for liquids of high pola ability (and hence light-scattering power and co pressibility, which is confirmed by experiment) a low for monatomic liquids (e.g. mercury).

534.321.9 : 533.21 = 5 *see Abstr.* 550

534.321.9 : 534.22 : 532.7 5

Ultrasonic propagation in liquids. II. Theoreti study of the free volume model of the liquid sta KITTEL, C. *J. Chem. Phys.*, **14**, 614–24 (*Oct.*, 1946). Using the Tonks equation [Abstr. 295 (1937 expressions are derived for the sound velocity, a the temperature and pressure coefficients of sou velocity. These expressions are compared wi experimental results. Expressions are also given f the cubic expansion coefficient and the difference the specific heats on the free volume model. Th Herzfeld–Rice derivation of the sound absorptio caused by phase shifts in the vibrational specific hea is carried through for the Tonks equation of stat The temperature and pressure coefficients of soun absorption are discussed. Remarks are made on th relation of molecular structure to sound absorption A

534.321.9 : 534.614 56

Ultrasonic propagation in liquids. I. Applicatio of pulse technique to velocity and absorption measure ments at 15 megacycles. PELLAM, J. R., AND GALT J. K. *J. Chem. Phys.*, **14**, 608–14 (*Oct.*, 1946).—Pulses of 1 μsec duration are generated by a trans ducer, which also picks up the resultant echoes from a plane reflector. Velocity measurements are made by determining the distance the transducer must be moved to delay the received echoes by a specified increment. Absorption measurements are made by determining the attenuation necessary to keep the receiver signal constant as the transducer is moved. The attenuation factor can be measured to an accuracy of about 5% and velocity to about 0·05%. Measurements in homologous series of organic liquids are reported. A.

534.321.9 : 534.614 = 4 563

On the dispersion of ultrasonics in carbon disulphide OUANG, T. T. *C.R. Acad. Sci., Paris*, **222**, 1165–6 (*May* 15, 1946) *In French.*—Velocity measurements were made by the diffraction method, using a Hg vapour arc. A table of results shows how the velocity decreases from 1 175 m/sec, at 400 kc/s, to 1 149·9 m/sec, at 1 360 kc/s (at 14·6°c). At the latter frequency the relative variation of velocity is $> 2\%$. G. F. H.

534.321.9 : 621.395.61 564

An ultrasonic condenser microphone. BONN, T. H. *J. Acoust. Soc. Amer.*, **18**, 496–502 (*Oct.*, 1946).—The microphone has an overall diameter of 0·875 in, with active diameter of the diaphragm 0·385 in. The diaphragm is 0·001 in duralumin stretched almost to the elastic limit. Its free-field calibration is essentially constant at a level of 51 db below 1 V/dyne cm^{-2} up to 32 kc/s. A.

534.4 : 621.3.012.8 = 396 565

Example of an equivalent circuit for an acoustic system. WANGENSTEEN, H. *Elektrotek. Tidsskr.*, **39**, 352–7 (*Nov.*, 1946) *In Norwegian.*—The system consists of 2 circular membranes, 2 holes or short collars and 3 coupled spaces *a*, *b*, *c*, small compared with the wavelength. The membranes have 1 degree of freedom and may be replaced by stiff pistons. The spaces *a* and *b* are in series, separated by one membrane, the other closing *a* to the left. The holes open from the sides of *a* and *b* into *c*. The left membrane is subject to a force $\sqrt{(2)}Ke^{j\omega t}$. The dynamical equations are established and two equivalent circuits are constructed, (1) putting force = e.m.f., velocity = current, mass = inductance, compressibility = capacitance, (2) force = current, velocity = e.m.f., mass = capacitance, compressibility = inductance. J. A. W.

534.414 = 5 566

Inertia, due to sound radiation, of a rigid diaphragm inserted in the surface of a closed air-filled vessel. BORDONI, P. G., AND GROSS, W. *Ric. Sci. Ricostruz.*, **16**, 615–17 (*May–June*, 1946). *Pubbl. Ist. Naz. Elettroacust. O.M. Corbino* (*No.* 54) (1946). *Atti. Accad. Naz. Lincei*, **1** (*Nos.* 3–4) 395–401 (1946) *In Italian.*—The author obtains an expression in the form of an infinite series for the mass-inertia due to a vibrating spherical cap inserted in the surface of a spherical vessel. A method is given for summing this slowly convergent series. Some numerical computations are made. V. C. A. F.

534.414 = 5 567

The effect of viscosity and thermal conduction in an acoustic resonator. BARDUCCI, I. *Ric. Sci. Ricostruz.*, **16**, 934–7 (*July*, 1946) *In Italian.*—Considers a resonator with a circular orifice and having its linear dimensions smaller than the wavelength of the sound waves, so that the resonator may be treated as having one degree of freedom. Formulae are derived for the acoustic impedance when account is taken of viscous and thermal losses, and for the coefficient of resonance of the resonator. V. C. A. F.

534.612 568

A new sound measurement system. MASSA, F. *Communications*, **26**, 16, 17, 19, 50 (*Oct.*, 1946).—Describes self-contained portable apparatus for the measurement of sound pressure, consisting of a microphone, single-stage pre-amplifier and two-stage auxiliary amplifier. The microphone ($\frac{5}{8}$ in dia.×1 in long) is a stiffness-controlled piezo-electric unit of high acoustic impedance and develops about 23 μV/dyne cm^{-2} for pressure normal to the diaphragm up to 45 kc/s. Directional effects are noticeable only at and above 10 kc/s. The electrical impedance is that of 100 pF at all frequencies. The microphone is mounted on a probe containing the pre-amplifier, and may be used to explore quite small enclosures without disturbing the field. The amplifier gain is standardized so that the output is 1 mV/dyne cm^{-2}; the microphone output is equal to the thermal agitation voltage in the 100 MΩ grid resistor of the first amplifier for a level of about 20 phons from 300 to 3 000 c/s. The microphone response is linear up to pressures of the order 10^6 dyne/cm^2. C. F. B.

534.614 569

Determination of transverse wave velocities in solids. PARSHAD, R. *Nature, Lond.*, **158**, 789 (*Nov.* 30, 1946).—Vibrations transmitted to a solid surface from a quartz crystal laid upon it were picked up by another crystal on the same surface, and amplified. By moving a crystal, maxima and minima of response were obtained, from which the wavelength may be measured. [See Abstr. 419 (1946)].

534.614 : 534.321.9 *see Abstr.* 562

534.614 : 534.321.9 = 4 *see Abstr.* 563

534.78 570

Effects of amplitude distortion upon the intelligibility of speech. LICKLIDER, J. C. R. *J. Acoust. Soc. Amer.*, **18**, 429–34 (*Oct.*, 1946).

534.78 571

On the intelligibility of bands of speech in noise. EGAN, J. P., AND WIENER, F. M. *J. Acoust. Soc Amer.*, **18**, 435–41 (*Oct.*, 1946).

534.78 572

Training for voice communication. BLACK, J. W., AND MASON, H. M. *J. Acoust. Soc. Amer.*, **18**, 441–5 (*Oct.*, 1946).

534.83 573

Underwater noise due to marine life. LOYE, D. P., AND PROUDFOOT, D. A. *J. Acoust. Soc. Amer.*, **18**, 446–9 (*Oct.*, 1946).

534.832 574

The effects of acoustical treatment in industrial areas. BERRIEN, F. K., AND YOUNG, C. W. *J. Acoust. Soc. Amer.*, **18**, 453–7 (*Oct.*, 1946).

534.836 575

Noise levels due to an airplane passing overhead. WIENER, F. M., AND MARQUIS, R. J. *J. Acoust. Soc. Amer.*, **18**, 450–2 (*Oct.*, 1946).

534.843 576

The effect of non-uniform wall distributions of absorbing material on the acoustics of rooms. FESHBACH, H., AND HARRIS, C. M. *J. Acoust. Soc. Amer.*, **18**, 472–87 (*Oct.*, 1946).—The theoretical treatment given here shows that it is only necessary to know the pressure distribution on the absorbing surfaces to predict completely the acoustic properties of the room. Methods are given for solving the equations using a new concept, the "effective admittance." Particular attention is given to the case of strips of absorbing materials, and some experimental results for such a case are given. The case of non-uniformly lined ducts is also treated. A.

534.845 577

Absorption of sound by coated porous rubber wall-covering layers. KOSTEN, C. W. *J. Acoust. Soc. Amer.*, **18**, 457–71 (*Oct.*, 1946).—A republication of earlier work [Kosten and Zwikker, *Physica*, **8**, 251–72, 933–78 (1941)]. A detailed theory is developed, and numerous experimental results are given, which approximately agree with it. A.

534.851 578

Measurement of recording characteristics by means of light patterns. BAUER, B. B. *J. Acoust. Soc. Amer.*, **18**, 387–95 (*Oct.*, 1946).—A comprehensive treatment of the theory and practical applications of the study of the light pattern reflected from a disc record, both for lateral and hill-and-dale recording.

OPTICS . RADIATION . SPECTRA 535

535.23.08 : 621.317.794 579

The production of film type bolometers with rapid response. AIKEN, C. B., CARTER, W. H., JR., AND PHILLIPS, F. S. *Rev. Sci. Instrum.*, **17**, 377–85 (*Oct.*, 1946).—[See Abstr. 699 B (1947)].

535.241.39 : 535.376 *see Abstr.* 602

535.242.43 580

A multi-step sector photometer. VAN DEN AKKER, J. A. *J. Opt. Soc. Amer.*, **36**, 561–8 (*Oct.*, 1946).—Describes an instrument in which the sample and standard are rapidly alternated by mechanical means on the optical axis of the spectrograph. The sector used gives eleven equally spaced extinction levels of the standard. Details of the mechanism by which the alternation is produced are given and the application of the instrument to different classes of measurement is described. J. W. T. W.

535.245.24 : 628.972.6 581

Light distribution in rooms. MOON, P., AND SPENCER, D. E. *J. Franklin Inst.*, **242**, 111–41 (*Aug.*, 1946).—A theoretical treatment of the problems of inter-reflection of light in enclosures of various regular forms, leading to formulae and tables for the calculation of illumination in rooms of different sizes and proportions with different lighting arrangements. J. W. T. W.

535.247 : 669.18 : 778.3 : 536.521 *see Abstr.* 615

535.247.4 : 535.361.2 582

A goniophotometer for gloss and colour measurements. HARRISON, V. G. W. *J. Sci. Instrum.*, **24**, 21–4 (*Jan.*, 1947).—A goniophotometer for determining to an accuracy of about 1% the reflecting properties of surfaces of low and medium gloss is described. Arrangement is made for the inclusion of Polaroid and coloured filters when desired. The specimen holder may be rotated about two axes, perpendicular to and parallel to, the plane of incidence, and the specimen itself may be rotated in its own plane through 360°. The photometer consists of a barrier-layer type photocell connected to a Tinsley galvanometer. Two specimen polar curves obtained with the instrument are reproduced. A.

535.316 583

Systematic constructional tables for thin cemented aplanatic lenses. BROWN, E. D., AND SMITH, T. *Philos. Trans.* (*No.* 814) 59–116 (*Oct.* 31, 1946).—The tables provide the information necessary in the construction of a lens made from only 2 refracting media when the magnification is −1 or 0. In the first case the lens is symmetrical and consists of 3 refracting elements, the first and third being the same. In the second case the lens is unsymmetrical and is made of one element only of each medium. The tables cover a range of refractive indices from 1·33333 to 2·00000. L. S. G.

535.32 584

The influence of boric oxide on the refractive index and dispersion of soda–boric oxide–silica glasses. WANG, T. H., AND TURNER, W. E. S. *J. Soc. Glass Tech.*, **29**, 390–6 (*Dec.*, 1945).—New measurements of refractive index, dispersion and v value, to revise earlier [*J. Soc. Glass Tech.*, **7**, 155 (1923)] data. A.

535.324.2 585

Refractive index of ethanol–water mixtures and density and refractive index of ethanol–water–ethyl ether mixtures. SCOTT, T. A., JR. *J. Phys. Chem.*, **50**, 406–12 (*Sept.*, 1946).

535.33–15 586

Infrared emission spectra of liquids. KAPFF, S. F. *Science*, **104**, 274–5 (*Sept.* 20, 1946).

535.33 : 536.66 : 539.133 *see Abstr.* 661

535.33 : 537.531 *see Abstr.* 636

535.33 : 538.615 = 4 587

The application of classical radiation theory to the Zeeman effect in octopolar spectral lines. DURAND, E. *C.R. Acad. Sci., Paris*, **222**, 1044–6 (*April* 29, 1946) *In French.*—Quotes a previous paper [*C.R. Acad. Sci., Paris*, **219**, 584–6 (1944)], in which an expression is found for the components of the octopolar electric field; two lines are produced, with frequencies in the ratio of 3 : 1. The Larmor precession is determined for the case when a magnetic field is applied and the frequencies, states of polarization and relative intensities of the resultant lines are calculated. The author restricts this treatment to cases where there is no spin. N. C.

535.33.072–15 : 621.383.8 588

Use of lead sulphide cells in infra-red spectroscopy. SUTHERLAND, G. B. B. M., BLACKWELL, D. E., AND FELLGETT, P. B. *Nature, Lond.*, **158**, 873–4 (*Dec.* 14, 1946).—The cells are of the order of 100× more sensitive than thermocouples in the region 1 to 3·4 μ, and have a short response time (0·001 sec). Resolutions of the order of 0·05 cm^{-1} should be possible, though spectrometer optics may need improvement. A spectrograph of the H_2O band at 3 970 cm^{-1} is shown, in which a doublet of 0·14 cm^{-1} is resolved.

535.338.4 = 4 589

Extension of the $A(^3\Sigma)$–$X(^1\Sigma)$ band system of the nitrogen molecule. HERMAN, R. *C.R. Acad. Sci., Paris*, **222**, 1226–7 (*May* 20, 1946) *In French.*

535.341 = 3 590

The variation with the pressure of the absorption of light by oxygen in the region 2 100 to 2 400 Å. HEILPERN, W. *Helv. Phys. Acta*, **19** (*No.* 4) 245–64 (1946) *In German.*—The absorption coefficient was measured at 9 different pressures between 50 and 130 kg/cm², and was found to follow the law $A = A_0 \exp(2{\cdot}12 \pm 0{\cdot}01)p$ independent of the wavelength. A.

535.341 : 621.396.11 591

Millimetre wave propagation. LAMONT, H. R. L., AND WATSON, A. D. G. *Nature, Lond.*, **158**, 943–4 (*Dec.* 28, 1946).—[Abstr. 770 B (1947)].

535.341–15 592

The experimental determination of the intensities of infra-red absorption bands. I. Theory of the method. WILSON, E. B., JR., AND WELLS, A. J. *J. Chem. Phys.*, **14**, 578–80 (*Oct.* 1946).—With spectrographs of available resolving power, the apparent integrated absorption coefficients of infra-red bands usually differ greatly from the true coefficients because the spectrograph yields at each setting a weighted average of the fractional light transmitted in a band of frequencies, whereas what is desired is the unweighted average of the logarithm of the fractional light transmitted. It is shown that true absorption coefficients can be obtained by (*a*) eliminating the violent fluctuations in intensity with frequency by broadening the rotational lines with a non-absorbing foreign gas and (*b*) eliminating the error due to the intensity variation of the envelope by extrapolating the apparent integrated absorption coefficient divided by the partial pressure to zero partial pressure of the absorbing gas. These two steps permit vibrational intensities to be measured to a reasonable accuracy even with a spectrograph of low resolving power. A.

535.343.2 : 548.0 : 539.132 593

Absorption spectra of crystals at low temperatures. IV. Absorption spectrum of napththalene at 20·4°K. PRIKHOTJKO, A. *J. Phys., USSR*, **8** (*No.* 5) 257–75 (1944).—The spectra of single crystals, varying in thickness from 0·6 to 10^{-6} cm, were photographed in polarized and non-polarized light at the temperature of liquid hydrogen. Several absorption bands and lines were obtained, and their positions were measured. The intensity of some lines changes markedly with a change in the direction of the polarization vector. By comparing the absorption spectrum of a single crystal with the spectra of its fluorescence at 20·4°K, with the Raman spectra and with the spectra of vapours and naphthalene solutions, the electronic levels and the proper frequencies of the intermolecular vibrations and the vibrations of the crystal lattice were determined. For the method of classifying the absorption lines, see Abstr. 653 (1947). L. S. G.

535.343.2 : 549.211 594

The absorption spectrum of diamond in the visible region. RAMANATHAN, K. G. *Proc. Indian Acad. Sci. A*, **24**, 145–9 (*July*, 1946).—Weak blue-fluorescent diamonds completely cut off visible radiation less than 4 160 Å when absorption paths are more than a few cm. At the temperature of liquid air, a whole series of electronic absorption lines are observed. Absorption bands with centres at 4 512, 4 625, and 4 776 Å have been recorded and are considered to be characteristic of all blue fluorescent diamonds. W. R. A.

535.343.2–15 : 549.211 595

Variations in the absorption of infra-red radiation by diamond. RAMANATHAN, K. G. *Proc. Indian Acad. Sci. A*, **24**, 130–6 (*July*, 1946).—The coefficients for 37 cleavage plates have been measured in the 8 μ region by a residual ray method. Some cleavage plates exhibit patterns of i.r. transparency in this region, analogous to the patterns of u.v. transparency and of luminescence. W. R. A.

535.343.2–31 : 549.211 596

The absorption of ultra-violet radiation by diamond. RAMANATHAN, K. G. *Proc. Indian Acad. Sci. A*, **24**, 137–44 (*July*, 1946).—The spectra of two very thin wedges ($\gtrsim$0·2 mm thick) showed transmission up to 2 240 Å, and in one of them, a blue luminescent specimen, five new absorption bands were discovered below 2 300 Å. The variation with wavelength of the absorption coefficient of the blue luminescent specimen was determined from 3 030–2 570 Å. The u.v. transmission of several diamonds has been obtained for different photographic exposures and the data correlated with their luminescence and mean i.r. absorption coefficient in the 8 μ region. W. R. A.

535.345.6 597

Plastic filters for the visible and near infra-red regions. SHENK, J. H., HODGE, E. S., MORRIS, R. J., PICKETT, E. E., AND BRODE, W. R. *J. Opt. Soc. Amer.*, **36**, 569–75 (*Oct.*, 1946).—Describes the preparation of a number of filters giving a sharp cut-off at different wavelengths in the visible and near infra-red. The chemical composition of the 15 dyes found suitable as filters, and of the plastics used as bases, are given. J. W. T. W.

535.345.6–31 598

A Christiansen filter for the ultra-violet. MINKOFF, G. J., AND GAYDON, A. G. *Nature, Lond.*, **158**, 788 (*Nov.* 30, 1946).—Crushed CaF_2 mixed with 43 : 57 mixture of CCl_4 and EtOH at 18·6°C transmits radiation of $\lambda = 2\,537$ Å, for which the solid and liquid refractive indices are the same, and scatters other wavelengths, since the two dispersion curves are not the same. Temperature controls the transmitted wavelength by 10 Å/deg. C. Accurately parallel light must be used, focussed on a slit after passage through the cell. A region about 50 Å broad is transmitted, the transmission at the centre being 1 to 2%.

535.361 599

Radiation in a diffusing medium. BENFORD, F. *J. Opt. Soc. Amer.*, **36**, 524–54 (*Sept.*, 1946).—A mathematical treatment of the distribution of radiation within a plate of diffusing medium when the incident radiation is perfectly diffused. Expressions are obtained for the reflectance and transmittance of a plate of any thickness, given these quantities for a plate of unit thickness. The case of a number of plates of different media in different arrangements is also treated. The angular distribution of the radiation at any point within a medium is found. J. W. T. W.

535.361.2 : 535.247.4 *see Abstr.* 582

535.375.5 600

Temperature dependence of the intensities of Raman lines. VENKATESWARLU, K. *Nature, Lond.*, **159**, 96–7 (*Jan.* 18, 1947).

535.375.5 : 539.11 *see Abstr.* 652

535.375.5 : 549.211 601

Raman spectrum of diamond under high resolution. KRISHNAN, R. S. *Nature, Lond.*, **159**, 60–1 (*Jan.* 11, 1947).—Using Hg 2 536·5 Å radiation and a large quartz spectrograph, the faint 2nd order spectrum has been resolved into a number of discrete lines, the wave-number shifts of twelve of which are given.

535.376 : 535.241.39 602

Radioactive light sources. BLAU, M., AND FEUER, I. *J. Opt. Soc. Amer.*, **36**, 576–80 (*Oct.*, 1946).—Secondary standard light sources comprising luminescent screens excited by α-particles from Ra or Po. Ra sources give substantially constant light output if the screen is excited for short periods only, but correction for β- and γ-radiation may be required. Po sources give an exponentially decaying light output. The brightness may be varied by altering the separation of screen and source, by altering the gas pressure in the container, or by introducing absorbing screens. Initial calibration against standard sources is required. Brightnesses of 1 to 2 μlambert are given by ZnS.Cu screens with a source at 4 mm distance of 1 μg Ra/cm² or of 6 μcurie Po/cm². ZnS of blue or violet luminescence, with a Po source, does not show saturation of light output even at 300 μlambert. The authors discuss the dependence of brightness on α-particle range, and applications of the device to the study of cathodo-luminescence and in simple control circuits. S. T. H.

535.39 603

Experimental and theoretical results in two-layer low reflecting coatings for glass. KING, P., AND LOCKHART, L. B. *J. Opt. Soc. Amer.*, **36**, 513–17 (*Sept.*, 1946).—From the formula derived by Salzberg (not yet published), considering zero absorption and normal incidence, for a transparent surface with two transparent films of different thicknesses and refractive indices, it is shown that, for films of thickness $\lambda/4$ (λ = wavelength), the condition for zero reflectivity is $n_2 = n_3\sqrt{n_1}$, in agreement with Mooney [Abstr. 459 (1946)], where n_1, n_2, n_3 are the refractive indices of the material coated, of the first, and of the second film respectively. Zero reflectivity can be obtained for thicknesses other than $\lambda/4$, and many suitable combinations of n_1, n_2, n_3 for films of varied thicknesses exist. All the experimental coatings were deposited, from solution, on glass, and the refractive index of the coating material could be made to have any value between 1·47 and 2·0. Good agreement is obtained between the experimental and theoretical curves of variation of minimum reflectivity, and of spectral reflectivity, for various film thicknesses. Different combinations of film thicknesses and refractive indices can be chosen to produce identical curves. The frequency of minimum reflectivity and the amount of light reflected at the minimum can be changed at will, but the best arrangement to produce zero reflectivity for a particular frequency is not yet known. S. W.

535.39 = 4 604

Deposition of surface layers to increase or reduce reflection factor. ARNULF, A. *Le Vide*, **1**, 129–36 (*July–Sept.*, 1946) *In French.*—The paper deals with the practical details of methods for depositing the layer by evaporation in vacuo, cleaning of the surfaces and maintenance of a high vacuum. N. C.

535.39 = 5 605

Study of the optical properties of thin metallic films. SCANDONE, F., AND BALLERINI, L. *Nuovo Cim.*, 3, 81–115 (*April*, 1946) *In Italian.*—The theory of light transmission through the films is developed along the lines of Drude's method, and several interesting conclusions are reported. For any ang of incidence there exists a thickness of maximu absorption (not interferential), which may be regard as a "resonance" thickness. The variation of r flectivity with angle of incidence shows no inte ferential maxima and minima, as with dielectri films. A

535.42 : 535.8 = 4 60

Transmission factors and diffracted light. I. DUFFIEUX, P. M., AND LANSRAUX, G. *Rev. Opt (Théor. Instrum.)*, **24**, 65–84 (*April–June*, 1945) *In French.*—Two complex functions $F(x, y)$, $G(u, v)$ specify the light disturbance in the exit pupil and image of a point source respectively. They are related by a Fourier transformation; by an application of Parseval's theorem, $F(x, y)$ appears as a "transmission factor" relating the light disturbances in the object and image planes, when the object points are coherent. A function $E(u, v)$ describes the intensity distribution in the image of a point source. A function $D(x, y)$ (physically unreal), analogous to $F(x, y)$, derives from $E(u, v)$ by a Fourier transformation. $D(x, y)$ is related to $F(x, y)$, and is a "transmission factor" for non-coherent object points. From $F(x, y)$, $D(x, y)$, further "transmission factors" can be derived, which are of importance in the theory of test objects for optical instruments. To such a derived factor $d(x)$—a complex function—are related the resolving power and degree of stigmatism in the image, the object points being non-coherent. Theorems are given relating the form of $d(x)$ to that of $F(x, y)$ and its derivatives. A discussion is given in which it is shown that a line test-object across which the intensity is $I(u) = A_0 + A\cos 2\pi nx$ gives rise to an image in which the intensity variation is again sinusoidal. H. H. HOP.

535.651 : 621.383 607

Electronic spectroscopy. SZIKLAI, G. C., AND SCHROEDER, A. C. *J. Appl. Phys.*, **17**, 763–7 (*Oct.*, 1946).—The threshold potential at which a photoelectric current starts to flow depends on the wavelength of the light. By analysing the current/time distribution when a saw-tooth potential wave is applied to a photocell, the spectral composition of the incident light may be determined. The accuracy is limited by indefiniteness of threshold and non-linear output, but the device is useful for automatic colour matching by balancing two similar circuits.

535.8 : 535.42 = 4 *see Abstr.* 606

HEAT 536

536.2 608

The calculation of variable heat flow in solids. EYRES, N. R., HARTREE, D. R., INGHAM, J., JACKSON, R., SARJANT, R. J., AND WAGSTAFF, J. B. *Philos. Trans. A* (*No.* 813) 1–57 (*Aug.* 2, 1946).—The main purpose of the paper is to develop a method of calculating variable heat flow free from the restriction to constant diffusivity. The partial differential equation describing the flow is replaced approximately by a set of ordinary simultaneous equations, and the form of these is very suitable for solution by the differential analyser. The results of calculations

of variable heat flow are given for materials in which the thermal properties are independent of the temperature. The general case where the properties depend on the temperature is also treated and results compare well with experiment. A problem studied in detail is the cooling of an ingot in a mould, when heat flow is by conduction through the material of the ingot and the mould, and by radiation across the gap between them. [See also Abstr. 508 (1947)]. L. S. G.

536.2 : 517.944 *see Abstr.* 508

536.2.01 609

The thermal conductivity of bismuth at low temperatures. SHALYT, S. *J. Phys., USSR*, **8** (*No.* 5) 315–16 (1944).—The problem is whether the conductivity is due to the crystal lattice alone, or due also to electrons. The effect of a magnetic field on the conductivity of a cylinder of Bi is investigated. A 4 200 oersted field raises the thermal resistance by 15 to 20% at 65–80°K, by 4% at 14–20°K, and has no effect at 2–4°K. The thermal resistance/temperature curve has a minimum at about 4°K. It is concluded that in the region of the minimum, heat transfer is chiefly due to the lattice and the physical cause of the minimum is scattering of the elastic waves on the walls of the specimen. L. S. G.

536.24.01 : 621.791.052 610

The theory of moving sources of heat and its application to metal treatments. ROSENTHAL, D. *Trans. Amer. Soc. Mech. Engrs*, **68**, 849–66 (*Nov.*, 1946).—[Abstr. 826B (1947)].

536.422 611

Vacuum sublimation of ice in bulk. BRADISH, C. J., BRAIN, C. M., AND MCFARLANE, A. S. *Nature, Lond.*, **159**, 28–9 (*Jan.* 4, 1947).—The design of a freeze-drying plant is described, and its principles and operation discussed.

536.422.1 = 4 612

The rate of evaporation of sulphur in air. FOURETIER, G., AND BOULLÉ, A. *C.R. Acad. Sci., Paris*, **222**, 1217–18 (*May* 20, 1946) *In French.*—S was allowed to evaporate under conditions in which diffusion is the actuating force, under a pressure head almost equal to the maximum v.p. of S at atmospheric pressure. Pure S evaporates at a rate of *c.* $1{\cdot}7\times10^{-5}$ g/hr when the surface density is 0·1 mg/cm². When the density is below this figure, the rate is about $1{\cdot}3\times10^{-5}$ g/hr. Triclinic S evaporates at $1{\cdot}3\times10^{-5}$ g/hr for densities up to 0·38 mg/cm². E. H. D.

536.423.15 613

Studies in vapor-liquid equilibria. I. A new dynamic method for the determination of vapor pressures of liquids. PUCK, T. T., AND WISE, H. *J. Phys. Chem.*, **50**, 329–39 (*July*, 1946).—The liquid is evaporated at a known rate by an electric heater, and, mixed with a measured flow of inert gas, is blown against a metal mirror at fixed temperature. The gas flow is adjusted till a mirror of condensed liquid just forms, and the composition of the mixture at this point gives the saturation vapour pressure. The method may be used for liquids with v.p. between 23 and 0·001 mm Hg.

536.48 : 534.22 614

"Second sound" in helium II. PESHKOV, V. *J. Phys., USSR*, **8** (*No.* 6) 381 (1944).—Landau, in his quantum theory of superfluidity [Abstr. 2532 (1942)] predicted 2 kinds of periodic motions in helium II, "ordinary" sound, having a velocity of 230 m/sec, and observed by Findlay [Abstr. 4606 (1938)] and "second" sound. Experiments are now briefly described in which "second" sound was observed. It was found to have a velocity of 19 m/sec at 1·4°K, which is close to the theoretical value [Abstr. 2986 (1945)]. L. S. G.

536.521 : 778.3 : 535.247 : 669.18 615

Photographic photometry applied to the measurement of liquid steel temperatures. HALL, J. A. *Photogr. J.*, **86B**, 117–32 (*Sept.–Oct.*, 1946).—The method used was to photograph the steel stream and a series of four standard sources of temperature on the same 16 mm cinema film, which was run through the camera five times in all. In this way, calibration data are available on each frame of the film. It is considered that an accuracy of ±10 or 20°C in the neighbourhood of 1 500°C (equivalent to ±10% or 20% in brightness) has been attained. Possible improvements are mentioned, and it is suggested that a fourfold improvement in accuracy can be achieved. Many of the films have been taken with very short exposures to individual frames; these show detail not visible to the naked eye, and throw considerable light on the errors of optical pyrometry of steel streams in the open. A.

536.531.087.6 : 621.317.39 = 5 616

Recording thermometer reading to 0·01°C. TORZO, G., AND RAIMONDI, D. *Ric. Sci. Ricostruz.*, **16**, 659–61 (*May–June*, 1946) *In Italian.*

536.532 617

Characteristics of thermocouples. WELLER, C. T. *Gen. Elect. Rev.*, **49**, 50–3 (*Nov.*, 1946).—Gives temp./e.m.f. curves, departure limits from these curves, operating ranges and applications of Pt–(Pt–10% Rh), chromel–alumel, Cu–copnic, Fe–copnic, and chromel–copnic thermocouples.

536.66 : 535.33 : 539.133 *see Abstr.* 661

THERMODYNAMICS 536.7

536.71 618

On higher order transitions. BRIDGMAN, P. W. *Phys. Rev.*, **70**, 425–8 (*Sept.* 1 *and* 15, 1946).—Results obtained by Lype [Abstr. 2587 (1946)] by an expansion of the thermodynamic potentials in Taylor's series are discussed and compared with those obtained by Ehrenfest for higher order transitions. The differences in the results of the two investigations are attributed to different conceptions of the nature of the physical phenomena which are incompatible with one another. That discussed by Lype corresponds to a higher order transition existing at a single point only, and that dealt with by Ehrenfest may be considered as a degenerate case of this. A general mathematical relationship for the case discussed by Ehrenfest is deduced and its application considered. A brief review is given of the physical conditions under which phase equilibria of even order may be expected to occur, and it is indicated

that there may be some evidence for the existence of a singular point consistent with Lype's analysis in the case of NH_4Br. F. E. H.

536.71 = 4 619

Entropy sources and stationary states of polythermal systems. PRIGORINE, I., AND GÉHÉNIAU, J. *C.R. Acad. Sci., Paris*, **222**, 1085–7 (*May* 6, 1946) *In French.*—A theoretical note. A polythermal system, capable of chemical reaction, is considered, and the equation for the evolution of entropy, in which the sources of entropy are represented by a chemical and a thermal term, is stated [see Géhéniau, *J. Acad. Roy. Belg., Cl. des Sc.*, **28**, 283 (1942); **29**, 31 (1943)]. The formula for the composition of the system for a stationary chemical state is derived, and applied to the case of a plasma [see Abstr. 515 (1940)]. S. W.

ELECTRICITY 537

537/.538 : 373.63 : 621.3 620

Teaching electricity and magnetism. HESSLER, V. P. *Trans. Amer. Inst. Elect. Engrs*, **65**, 828–33 (*Dec.*, 1946).—[Abstr. 602 B (1947)].

537.122 621

Polyelectrons. WHEELER, J. A. *Ann. N.Y. Acad. Sci.*, **46**, 221–38 (*Oct.* 11, 1946).—Entities, consisting of electrons and positrons only, bound together in a structure similar to that of ordinary atoms, are considered from a theoretical point of view. The symbols P^{+-}, P^{++-}, P^{+--}, etc., are used to denote such entities; P^{+-}, for example, standing for a "bi-electron" consisting of one electron and one positron. It is shown that P^{+-} is stable against dissociation by 6·77 eV, that the tri-electron, P^{++-} or P^{+--}, is stable against dissociation of any kind by at least 0·1906 eV; P^{++--} has not been treated for all possible dissociations but it is shown that it is stable against dissociation into four free particles by 9·93 eV. The lifetime of excited states of P^{+-} is shown to be small compared with its lifetime against annihilation, and therefore it is possible for such an entity to emit radiation in the visible spectrum. The probability of formation of P^{+-} is considered, the most likely method being the impact of a γ-ray on an atomic nucleus. It is shown that the abundance ratio of P^{+-} to the number of pairs of free electrons and positrons formed is about 10^{-6}. Suggestions are made for possible methods for testing the formation of such entities experimentally, and consideration is given to their existence in cosmic radiation. The question is raised, in a tentative manner, as to whether the meson is a polyelectron. W. E. D.

537.122 622

Binding energy of polyelectrons. ORE, A. *Phys. Rev.*, **70**, 90 (*July* 1 *and* 15, 1946).—Arguments are put forward which suggest, although they are not conclusive, that the polyelectron P^{++--} [Abstr. 621 (1947)] is unstable against dissociation into two bi-electrons, and therefore the formation of higher polyelectrons is unlikely. W. E. D.

537.122 : 537.212 623

Determination of the electronic charge by the oil-drop method. HOPPER, V. D. *Nature, Lond.*, **158**, 786–7 (*Nov.* 30, 1946).—Variations in the rate of rise of drops in a vertical-field apparatus were found to be due to field inhomogeneity caused by a 1-mm hole in the top plate. It is shown that Millikan's determination [Abstr. 660 (1917)] needs no correction, but Bäcklin and Flemberg's [*Nature*, **137**, 655 (1936)] probably does; a hole of 0·6 mm dia. would have caused the difference between their result and Millikan's.

537.212 : 532.525 624

The field of a charged semi-infinite rectangular conductor parallel to an earthed infinite plane conductor or the flow from a thick walled jet. DAVY, N. *Phil. Mag.*, **37**, 207–16 (*March*, 1946).—A two-dimensional problem solved by some Schwarz–Christoffel transformations involving elliptic functions. L. S. G.

537.212 : 537.122 *see Abstr.* 623

537.222 625

Surface charge of "electrets." PARTINGTON, J. R., PLANER, G. V., AND BOSWELL, I. I. *Nature, Lond.*, **158**, 835–6 (*Dec.* 7, 1946).—The variations with time of surface charge on both anode and cathode faces of electrets of various compositions are shown in curves.

537.226 : 532.74 626

The dielectric properties of liquid mixtures. OSTER, G. *J. Amer. Chem. Soc.*, **68**, 2036–41 (*Oct.*, 1946).—The Onsager–Kirkwood theory of dielectric polarization has been applied to solutions of polar molecules. A correlation parameter, which is a direct measure of the extent and nature of molecular association, has been calculated for solutions of polar molecules in non-polar solvents ($COMe_2$–CCl_4; $PhNO_2$–C_6H_{14}; $Bu^{\alpha}Br$–C_7H_{16}; EtOH–C_7H_{16}; EtOH–C_6H_{14}). All the systems show parallel association of dipoles in solutions of high concentration, antiparallel association at lower concentration, and in dilute solution dipoles are free. The extent of association is increased at low temperature. Small concentrations of polar molecules in water alter the permittivity of water in a manner predictable from a knowledge of the correlation parameter. Dioxan lowers the permittivity of water abnormally, indicating strong interaction with water. W. R. A.

537.226 : 621.3.015.5 : 621.315.616.9 627

Intrinsic electric strength of polythene. OAKES, W. G. *Nature, Lond.*, **159**, 29–30 (*Jan.* 4, 1947).—For specimens varying in thickness from 0·0005 to 0·008 in, the breakdown voltage was observed to be a linear function of thickness. Below about 25°C it was nearly independent of temperature, but fell at temperatures above this, in qualitative agreement with Fröhlich's theory [Abstr. 328 (1947). See also Abstr. 32 B (1945)].

ELECTRIC CURRENTS 537.3

537.311.3 = 4 628

Study of the electrical conductivity of rare oxides: lanthanum, praseodymium, neodymium and samarium. FOREX, M. *C.R. Acad. Sci., Paris*, **220**, 359–61 (*March* 12, 1945) *In French.*

537.311.33 : 538 632 629

On the theory of electric properties of good conducting semi-conductors. SHIFRIN, K. *J. Phys.*,

USSR, **8** (*No.* 4) 242–52 (1944).—Some of the properties do not depend on the length of the mean free path of the electrons, and a study is made of the dependence of the concentration of the free electrons on (1) the concentration of the impurity, (2) the temperature. The variation of the degeneracy of the electron gas with heating is also studied. Other properties do depend on the length of the mean free path, and the electrical conductivity and differential thermo-electric force are investigated both for substances with an atomic lattice or an ionic lattice. The Hall effect is also discussed. The ordinary formulae cannot be applied to a semi-conductor when the concentration of the free electrons at room temperature exceeds 3×10^{18} per cm^3. L. S. G.

537.312.5 : 621.383.4 630

Response of photoconductive lead sulphide cells. Hepner, W. A. *Nature, Lond.*, **159**, 96 (*Jan.* 18, 1947).—A theoretical discussion is given of possible means of reducing the response time of the cells.

537.312.62 : 621.396.62 631

Demodulation by superconductivity. Andrews, D. H., and Clark, C. W. *Nature, Lond.*, **158**, 945–6 (*Dec.* 28, 1946).—Fluctuations in superconducting bolometers [Abstr. 61 (1947)] have been found to be due to the absorption and rectification by the bolometer of modulated broadcast radio-waves, of wavelengths around 1, 3, 5 or 16 Mc/s. The signal output was 10 to 100 μV, and audible quality good. The effect only occurred in a narrow temperature range of the bolometer.

ELECTRIC DISCHARGES AND RADIATIONS 537.5

537.525 632

Threshold potential, conductivity and course of a chemical change under electrical discharge. Joshi, S. S. *Curr. Sci.*, **15**, 281–2 (*Oct.*, 1496).

537.525 : 537.542 *see Abstr.* 639

537.525.5 633

Rate of growth of current in arc discharges. Froome, K. D. *Nature, Lond.*, **159**, 129 (*Jan.* 25, 1947).—Preliminary results are given for the case of a triggered condenser discharge through a low pressure tube. This discharge is an arc, because a "cathode spot" is needed to supply the very high currents at the low potentials used.

537.531 634

Absorption measurements for broad beams of 1- and 2-million-volt X-rays. Singer, G., Braestrup, C. B., and Wyckoff, H. O. *J. Res. Nat. Bur. Stand., Wash.*, **37**, 147–50 (*Aug.*, 1946).—Experimentally determined concrete-absorption curves are given for wide-angle X-ray beams produced by a 1- and 2-MV resonance generator. Data on the variation of X-ray intensity with the distance from a concrete barrier are included. With this information as a basis, the thickness of a concrete barrier necessary for protection against a broad X-ray beam has been computed for 1- and 2-MV X-rays, and for various tube currents and barrier-to-target distances. A.

537.531 : 53.081.4 : 548.73 635

The conversion factor for kX units to Ångström units. Bragg, W. L. *J. Sci. Instrum.*, **24**, 27 (*Jan.*, 1947).—It has been agreed that the factor shall be taken as 1·00202, which is probably correct to 0·003%. A table of wavelengths in Å of some emission lines and absorption edges is given.

537.531 : 535.33 636

On the intensity-distribution of the continuous X-ray spectrum near its short-wavelength limit. Nijboer, B. R. A. *Physica, 's Grav.*, **12**, 461–6 (*Oct.*, 1946).—As the potential across an X-ray tube is increased beyond the critical value $h\nu/e$ the intensity of rays with frequency ν rises steeply at first, then decreases and passes through a minimum about 20 V above $h\nu/e$ [see Abstr. 258 (1945)]. This behaviour is related to the density of unoccupied s states in the metal of the anticathode, which affects both the energy losses and the transition probabilities for X-ray emission. A. J. C. W.

537.533.72 : 539.165 637

A magnetic lens of special field form for β- and γ-ray investigations, designs and applications. Siegbahn, K. *Phil. Mag.*, **37**, 162–84 (*March*, 1946).—Glaser recently calculated a convex field form for a magnetic lens having zero spherical aberration [Abstr. 454 B, 2050 (1944)]. A lens of this type, of unorthodox construction, is described, and the magnetic field form is measured. The lens is used in a β-spectrograph and the resolving power and light intensity of the instrument is investigated. The light intensity is high, and it was possible to make spectroscopic determinations of the energies and intensities of the β- and γ-spectra when the sample available has a strength no greater than that required for a moderately good absorption measurement. Investigations were made of the β-spectrum of Mn^{56}, the γ-radiation of Na^{24}, Au^{199}, Mn^{56}, and of the complex γ-spectrum of Th (C + C′). L. S. G.

537.534 638

Triatomic hydrogen and Doppler effect in hydrogen positive rays. Dakshinamurti, C. *Nature, Lond.*, **159**, 27–8 (*Jan.* 4, 1947).

537.542 : 537.525 639

Rate of spread of discharge along the wire of a Geiger counter. Hill, J. M., and Dunworth, J. V. *Nature, Lond.*, **158**, 833–4 (*Dec.* 7, 1946).—Measurements were made on a counter 100 cm long, with two insulated parts of the cathode at each end. Velocities between 2 and 16 cm/μsec were measured, depending on the over-voltage and pressure of filling gas, but only slightly on the pressure of alcohol vapour. It is suggested that the propagation of the discharge is due to the acceleration of positive ions in the longitudinal direction by the distortion of the field at the edge of the ion sheath.

537.568 : 538.566.3 640

On the absorption of radio waves and the number of collisions in the ionosphere. Ginsburg, V. *J. Phys., USSR*, **8** (*No.* 4) 253–6 (1944).—Formulae are developed for the variation of the effective number of collisions of an electron per second, with the concentration of the molecules and ions and with the temperature. The cross section for collisions with

ions is about one million times greater than that for molecules under ionospheric conditions. The importance of this in determining the concentration of ions and molecules, especially in the *E*-layer, is discussed. L. S. G.

COSMIC RAYS 537.591

537.591.1 641

On the existence of the third component of cosmic rays. ALICHANOW, A., AND ALICHANIAN, A. *J. Phys., USSR*, **8** (*No.* 5) 314–15 (1944).—A continuation of previous work [Abstr. 2332–3, 2343 (1945)]. The measured intensity of soft radiation depends upon the measuring apparatus, a counter or an ionization chamber. To explain this, the "third component" is introduced. It is not connected genetically with either mesons, photons or electrons. L. S. G.

537.591.15 642

On the theory of cosmic showers in heavy elements. BELENKY, S. *J. Phys., USSR*, **8** (*No.* 5) 305–13 (1944).—The present theory of showers is not applicable to heavy elements, and the reasons for this are given. An electron of large energy is incident on a block of matter and, because of various multiplicative processes, gives rise to a number of particles as it penetrates the block. The thickness at which the shower is a maximum is determined, and also the number of particles in the maximum. Exact expressions for photon absorption are used. The work of Corben on cascade processes [Abstr. 2595 (1941)] is criticized. L. S. G.

537.591.5 643

Solar and sidereal 6-hourly variations of cosmic rays. DUPERIER, A. *Nature, Lond.*, **158**, 944–5 (*Dec.* 28, 1946).

537.591.5 : 523.75 644

Cosmic ray intensity at Manchester and solar disturbances of July 25, 1946. DOLBEAR, D. W. N., AND ELLIOT, H. *Nature, Lond.*, **159**, 58 (*Jan.* 11, 1947).

537.591.8 : 539.172 *see Abstr.* 672, 673

MAGNETISM 538

538.081 : 621.317.4.081 : 621.317.2 : 389.6 = 82 645

Magnetic standards. SHRAMKOV, E. G. *Elektrichestvo* (*No.* 7) 42–51 (1946) *In Russian.*—A detailed account of the creation by the Russian Institute for Metrology of the first magnetic standards, based on the c.g.s.μ_0 system. A special laboratory, removed from magnetic disturbances and built from non-magnetic materials, houses three primary standards, magnetic field potential, magnetic current and magnetic moment. Inside the laboratory the non-uniformity of the terrestrial field is $\gtrsim 6\times10^{-5}$ oersteds. The standard of magnetic potential consists of a Helmholtz inductor of specific dimensions resulting in a max. departure from uniformity of $<0{\cdot}001\%$. The potential is calculated and also measured by means of a test magnet suspended in the centre of the field. The periods of oscillation of the magnet are observed in the terrestrial field only, and in the additional field of the coil energized by current. The standard of magnetic current consists of a double coil system, the first coil inducing a current in the second coupled coil. The standard of magnetic moment consists of a system of 4 rotational ellipsoids of Co steel, specially heat treated and stabilized by a.c. magnetization of decreasing potential, resulting in an annual change of 0·02–0·04%. Several further applications are described, such as the determination of the horizontal component of the terrestrial field and a more exact measurement of the absolute ampere. A detailed description of the construction technique and an analysis of the attainable accuracy are given, also a block diagram illustrating the relations between primary, secondary and working magnetic standards. A. L.

538.122 : 621.3.013.2 : 621.317.72.9 646

Use of the electrolytic tank for magnetic problems. PEIERLS, R. E. *Nature, Lond.*, **158**, 831–2 (*Dec.* 7, 1946).

538.221 = 4 647

The magnetic isotherms of the ferromagnetic compound CrTe and its spontaneous magnetization as a function of temperature. GUILLAUD, C. *C.R. Acad. Sci., Paris*, **222**, 1224–6 (*May* 20, 1946) *In French.*

538.222 : 541.128 648

A new magnetic effect applied to the structure of catalytically active solids. SELWOOD, P. W., HILL, F. N., AND BOARDMAN, H. *J. Amer. Chem. Soc.*, **68**, 2055–9 (*Oct.*, 1946).—The magnetic susceptibilities of catalysts comprising Cr_2O_3 on γ-Al_2O_3, MoO_2 on γ-Al_2O_3, and various "chromite" catalysts have been measured, and values show that the magnetic properties of a supported transition group oxide approach those of a magnetically dilute compound. The effect is considered to be of potential value in studying the structure of active solids, in estimating dispersion and surface area, and in studying the oxidation state of the activating agent. W. R. A.

ELECTROMAGNETISM ELECTRODYNAMICS 538.3/.5

538.32 649

Forces between linear circuits according to O'Rahilly. WENNER, F. *J. Wash. Acad. Sci.*, **36**, 294–6 (*Sept.* 15, 1946).—Discusses the formulae put forward since Ampère to calculate the force between linear electric currents, and, in particular, O'Rahilly's recent (1938) formula. This is shown to lead to the conclusion that there is no mutual potential energy between two circuits carrying currents. This is contrary to observations. V. C. A. F

538.565 : 621.396.611.4 = 4 650

On electromagnetic resonators. BERNIER, J. *Onde Élect.*, **26**, 305–17 (*Aug.-Sept.*, 1946) *In French.*—[Abstr. 780 B (1947)].

538.566 : 621.396.11 = 82 651

The field of a surface wave in the vicinity of a conducting body. FOK, V. A. *Bull. Acad. Sci. URSS, Sér. Phys.*, **10** (*No.* 2) 171–86 (1946) *In Russian.*—[Abstr. 771 B (1947)].

538.566.3 : 537.568 *see Abstr.* 640

538.615 : 535.33 = 4 *see Abstr.* 587

538.632 : 537.311.33 *see Abstr.* 629

538.71 : 550.381 : 622.1 : 621.317.44 = 397 *see Abstr.* 699

ATOMIC AND MOLECULAR STRUCTURE 539

539.11 : 535.375.5 652

Elastic constants of ice. BORN, M. *Nature, Lond.*, **158**, 830–1 (*Dec.* 7, 1946).—The five true elastic constants of hexagonal crystals of ice have been calculated on certain assumptions of the atomic configuration and numerical values based on the inadequate experimental measurements available are given. An explanation is offered for the broad band in the Raman spectrum—that water molecules can jump from one to another of 6 different orientations in the lattice.

539.132 653

On the investigation of electronic-vibrational levels in complicated molecules. GERMAN, V. *J. Phys., USSR*, **8** (*No.* 5) 276–84 (1944).—The determination of all possible types of levels means that of all irreducible representations of the substitution group of the Schrödinger equation, relating to the symmetry group of the molecule considered, those should be separated that are compatible with Pauli's principle for the given spin of the molecule. A method for carrying out this separation is described. It involves the use of group characters and the process is explained in detail with reference to the molecule $C_{10}H_8$. For a comparison with experiment, see Abstr. 593 (1947). L. S. G.

539.132 654

Intensities of electronic transitions in ammonia. THOMPSON, R. J., AND DUNCAN, A. B. F. *J. Chem. Phys.*, **14**, 573–7 (*Oct.*, 1946).

539.132 : 533.75 655

Influence of retardation on the London–van der Waals forces. CASIMIR, H. B. G., AND POLDER, D. *Nature, Lond.*, **158**, 787–8 (*Nov.* 30, 1946).—The effect of retardation on the mutual attraction of two neutral atoms has been calculated to be proportional to R^{-7} rather than R^{-6} when $R \gg$ the wavelength corresponding to the excitation energies of the atoms. A refined form of the London formula is given.

539.132 : 541.141.7 *see Abstr.* 690

539.132 : 541.57 656

The light absorption and resonance energies of some heterocyclic molecules. MACCOLL, A. *J. Chem. Soc.*, 670–2 (*Aug.*, 1946).—In view of the pronounced red shift of the long wavelength electronic absorption band of the cyclic molecules $[CH]_nN_{6-n}$ as n decreases, the quantum mechanics of these molecules has been investigated to the Förster approximation. The observed shifts can be accounted for if it is assumed that the C–C, C–N, N–N exchange integrals decrease in that order. The resonance energies of these compounds have also been determined, together with the zeroth order wave functions in those cases in which the two Kekulé forms are non-equivalent. A.

539.132 : 548.0 : 535.343.2 *see Abstr.* 593

539.133 657

The structure of ozone. GLOCKLER, G., AND MATLACK, G. *J. Chem. Phys.*, **14**, 505–6 (*Aug.*, 1946).—[See Abstr. 2928 (1946)].

539.133 658

Bending force constants for halogenated ethylenes. PITZER, K. S., AND FREEMAN, N. K. *J. Chem. Phys.*, **14**, 586–8 (*Oct.*, 1946).

539.133 659

A theoretical evaluation of normal frequencies of vibration of the isomeric octanes. AHONEN, C. O. *J. Chem. Phys.*, **14**, 625–36 (*Oct.*, 1946).

539.133 660

On the structure of ozone. EBERHARDT, W. H. *J. Chem. Phys.*, **14**, 641 (*Oct.*, 1946).—[See Abstr. 657 (1947)].

539.133 : 535.33 : 536.66 661

Heat of atomization of carbon. EDLÉN, B.; DUCHESNE, J., GOLDFINGER, P., AND ROSEN, B.; NORRISH, R. G. W., AND LONG, L. H. *Nature, Lond.*, **159**, 129–31 (*Jan.* 25, 1947).

539.133 : 541.57 662

The O–O bond energy in hydrogen peroxide. GLOCKLER, G., AND MATLACK, G. *J. Chem. Phys.*, **14**, 504–5 (*Aug.*, 1946).—[See Abstr. 541 (1946)].

539.152.2 : 539.154.3 : 539.181 *see Abstr.* 678

539.154.2 : 539.17 *see Abstr.* 670

539.154.3 : 539.152.2 : 539.181 *see Abstr.* 678

539.155.2 = 3 663

Rule concerning the missing isotone numbers. BREUSCH, F. L. *Experientia*, **2** (*No.* 9) 363 (1946) *In German.*—Nine of the neutron numbers (isotone numbers) between 1 and 126 are not represented by stable isotopes. These numbers each lie between those of the two isotopes of an element of odd atomic number. The converse of the rule is not true.

RADIOACTIVITY . NUCLEAR DISINTEGRATION . NUCLEAR PARTICLES 539.16/.18

539.16.08 664

An arrangement with small solid angle for measurement of beta rays. CURTISS, L. F., AND BROWN, B. W. *J. Res. Nat. Bur. Stand., Wash.*, **37**, 91–4 (*Aug.*, 1946).—A standard measuring system is described, by which the activities of sources as strong as 1 millicurie can be measured in terms of solid angle and counting rate only. A G.M. counter with small window some distance from the source is used; only sources which emit high-energy (>1 MeV) β-rays alone can be measured. The arguments in support of the new "Rutherford" unit are set out.

539.16.08 : 621.385.032.5 665

A Geiger counter for the determination of thorium content of thoriated-tungsten wire. AITCHISON, R. E.

A.W.A. Tech. Rev. (*Amal. Wireless Aust.*) **7** (*No.* 1) 1–7 (1946).—[Abstr. 732 B (1947)].

539.165 : 537.533.72 *see Abstr.* 637

539.166.8 = 5 666

Formation of electron-pairs by γ-rays in the field of an electron. BORSELLINO, A., AND GHIZZETTI, A. *Ric. Sci. Ricostruz.*, **16**, 625–8 (*May–June*, 1946) *In Italian.*—The authors consider the contribution due to the atomic electrons in the formation of electron-pairs by γ-radiation, as against that due to the nuclei. The effective cross-section for the process is calculated and the results are compared with an earlier evaluation by Perrin. V. C. A. F.

539.167.3 667

Corrected tables of radioactive isotopes and their properties. *Rev. Sci. Instrum.*, **17**, 348–51 (*Sept.*, 1946).—The tables correct those published in *Science*, **103**, 697 (1946) of the fission-product and neutron-induced isotopes to be made available by the Manhattan District Project. Half-lives, energy and type of radiations, and properties of radioactive daughters are given.

539.17 668

Astatine: the element of atomic number 85. CORSON, D. R., MACKENZIE, K. R., AND SEGRÈ, E. *Nature, Lond.*, **159**, 24 (*Jan.* 4, 1947).—The name proposed by the discoverers. The chemical symbol should be "At."

539.17 669

Technetium: the element of atomic number 43. PERRIER, C., AND SEGRÈ, E. *Nature, Lond.*, **159**, 24 (*Jan.* 4, 1947).—The name proposed by the discoverers. The chemical symbol should be "Tc."

539.17 : 539.154.2 670

The making of the missing chemical elements. PANETH, F. A. *Nature, Lond.*, **159**, 8–10 (*Jan.* 4, 1947).—A short review, with 16 references, of the history of the discovery of the elements hitherto missing from the periodic table. These elements are likely to be available soon in substantial quantities and should be formally named. The article indicates to whom this privilege belongs in each case.

539.172 671

Disintegration of magnesium and aluminium by deuterons. ALLAN, H. R., AND CLAVIER, C. A. *Nature, Lond.*, **158**, 832–3 (*Dec.* 7, 1946).—The range of protons emitted under 900 kV deuteron bombardment was measured, and the groups observed were allocated among the isotopes of Mg. The following Q-values were thus obtained: $Mg^{24}(d,p)Mg^{25}$, $4{\cdot}49 \pm 0{\cdot}05$; $Mg^{25}(d,p)Mg^{26}$, $5{\cdot}05 \pm 0{\cdot}05$; $Mg^{26}(d,p)Mg^{25}$, $4{\cdot}05 \pm 0{\cdot}05$; $Al^{27}(d,p)Al^{28}$, $5{\cdot}49 \pm 0{\cdot}06$ MeV. The results are used to build up a set of mass values for the elements between Ne and Si.

539.172 : 537.591.8 672

Nuclear disintegration by meson capture. PERKINS, D. H. *Nature, Lond.*, **159**, 126–7 (*Jan.* 25, 1947).—A "star" found in photographic emulsion exposed at 30 000 ft appears to indicate a disintegration caused by an ionizing particle showing a track in the emulsion, and reasons are given for believing it to be a slow meson. Possible disintegration schemes are discussed, and a mass indicated for the meson on the basis of them.

539.172 : 537.591.8 673

Multiple disintegration processes produced by cosmic rays. OCCHIALINI, G. P. S., AND POWELL, C. F. *Nature, Lond.*, **159**, 93–4 (*Jan.* 18, 1947).—More than 300 multiple disintegration "stars" were found in photographic emulsions exposed for 6 weeks at 3 800 m altitude. A particular type is discussed, in which one of the disintegration products is an excited Li^8 nucleus; this decays after about 10^{-12} sec (16 μ track length) to two α-particles, emitted in opposite directions, forming a T-shaped track.

539.172.11 674

Angular distribution of protons ejected in the disintegration of nitrogen by α-particles. CHAMPION, F. C., AND ROY, R. R. *Nature, Lond.*, **159**, 127 (*Jan.* 25, 1947).

539.172.4 675

Properties of 94 (239). KENNEDY, J. W., SEABORG, G. T., SEGRÈ, E., AND WAHL, A. C. *Phys. Rev.*, **70**, 555–6 (*Oct.* 1 *and* 15, 1946).—The fission of element 94^{239} with slow neutrons has been observed. The cross-section of the process, which is even greater than that for U^{239}, was determined by comparing the number of fissions obtained with a sample containing 94^{239} with the number obtained with a sample of ordinary U under identical conditions. Two tests were used to prove that the fissions in the 94^{239} sample were not due to U impurity: (1) by showing the absence of U in the final product by the absence of U α-particles, and (2) by showing that the ratio of the cross-section for slow neutrons to that for fast neutrons for the fission of 94^{239} is different from that for natural U. The half-life of 94^{239} is approximately 3×10^4 years. A. J. M.

539.172.4 676

Determination of the upper limits of the fission cross-sections of lead and bismuth for Li–D neutrons by a chemical method. BRODA, E., AND WRIGHT, P. K. *Nature, Lond.*, **158**, 871–2 (*Dec.* 14, 1946).—A search was made for radio-iodine in Pb and Bi after 6½ hours of irradiation by neutrons from Li + 9 keV deuterons. Iodine was chosen as it is in the middle of one of the groups of U fission products, and can be easily extracted chemically. The activity was compared with that of the iodine recovered from a sample of U similarly irradiated, and corrections made for the different weights of material irradiated, relative abundance of the various isotopes, and the neutron spectrum (theoretically, Pb and Bi are only fissionable by neutrons > 4 to 5 MeV energy). The upper limits for cross-sections (very approximate, in view of the assumptions made) are 4 to $9 \times 10^{-5} \times$ the U cross-section.

539.172.4 677

Determination of the upper limits of the fission cross-sections of lead and bismuth for Li–D neutrons by a track count method. BRODA, E. *Nature, Lond.*, **158**, 872–3 (*Dec.* 14, 1946).—Photographic plates loaded with Pb or Bi were searched for fission tracks after irradiation; none were found. Uranium-loaded plates were used as controls. After correcting for isotope abundance and "effective" neutrons [see

Abstr. 676 (1947)] the upper limits of cross-section are 5 to $10 \times 10^{-4} \times$ the U cross-section. No assumption on the constitution of the fission products is involved.

539.181 : 539.152.2 : 539.154.3 678

Atomic and molecular beams, some recent developments. KUHN, H. *J. Sci. Instrum.*, **23**, 249–55 (*Nov.*, 1946).

539.185 = 5 679

Distribution of neutrons from a point source of fast neutrons, in an infinite hydrogenous medium. I. Resonance neutrons. VERDE, M. *Nuovo Cim.*, **3**, 116–29 (*April*, 1946) *In Italian.*—The stationary state of distribution is worked out, on the basis of a mean free path Λ inversely proportional to the velocity, of the neutrons with energy >1 eV, taking into account collisions with the heavy nuclei of the medium as well as the protons. The distribution at great distances takes the form $\exp[-r\lambda_0(r)/\Lambda_0]/r$ where Λ_0 is the mean free path of the original neutrons. A.

539.185.7 680

On the scattering of neutrons by protons. SMORODINSKY, J. *J. Phys., USSR*, **8** (*No.* 4) 219–24 (1944).—A formula for the cross section, which is a modification of Wigner's formula [Abstr. 2929 (1936)] is proposed. The constants appearing in the formula are found from an analysis of experimental data, especially that of Amaldi, and no special assumption is made about the mode of interaction. The effect of the *P*-wave on scattering is discussed, and a formula is obtained for the cross-section for the *P*-scattering. This is a generalisation of the Bethe–Peierl's formula. A comparison of results is made with the scattering of protons by protons. L. S. G.

STRUCTURE OF SOLIDS 539.2

539.21 = 3 681

The constitution of amorphous solids. BRANDENBERGER, E. *Schweiz. Arch. angew. Wiss. Tech.*, **12**, 338–60 (*Nov.*, 1946) *In German.*—A review. Few solids are amorphous in the sense that X-ray or electron diffraction reveals no order. Solids not strictly periodic are divided into three groups: A, those built up from indefinitely long chains; B, those built up from indefinitely large layers; and C, those having a 3-dimensional structure in which no chains or layers can be distinguished. Group A is divided into those showing a fibre structure without mechanical treatment (Se, chrysotile, cellulose); those developing a fibre structure under mechanical treatment (rubber); and those that do not develop a fibre structure (polyvinylacetate). Group B is divided into those with periodic layers and a constant inter-layer spacing, the layers being subject to various translations and rotations; those with periodic layers but not a fixed inter-layer spacing; and those with various degrees of aperiodicity in the layers. Group C is divided into quasi-crystalline, in which there is a distorted lattice, and pseudo-crystalline, such as the glasses, in which there is not a lattice. There are fifteen figures, five tables, and two schemes of classification, one for chain formation and one for net formation. A. J. C. W.

539.213.1 : 666.115 682

The vitreous state. STEVELS, J. M. *Philips Tech. Rev.*, **8**, 231–7 (*Aug.*, 1946).—The factors which influence the tendency of a substance to solidify in the vitreous form are discussed. The most important cause is an association of the atoms of the liquid which leads to increasingly large complexes with decreasing temperature of the liquid. Under certain conditions these complexes have almost no tendency to pass over into a crystalline structure. The mass then solidifies in such a way that the arrangement of the atoms, considered over short distances, exhibits much similarity to that in a crystal, while over distances of more than a few atoms there is no regular arrangement. In the case of the glass-forming oxides, a detailed study is made of the characteristics of their structure responsible for their tendency to form glasses. A.

539.214 683

The plasticity of brittle materials. RYSCHKEWITSCH, E. *Industr. Diamond Rev.*, **6**, 339–44 (*Nov.*, 1946).—The author states that ceramic materials, as well as metals, show non-reversible plastic deformations well below their melting point. As evidence of this is cited the scratching by diamonds and rubies of polished surfaces of substances such as glass, sintered ruby, silicon carbide and sintered ZrO_2, in which curled chips are produced. Photo-micrographs of such scratches are given. L. G. C.

539.23 684

On the kinetics of the formation of oxide films on the surface of metals. FRENKEL, J. *J. Phys., USSR*, **8** (*No.* 4) 225–9 (1944).—The formation of a film begins with the dissociation of adsorbed oxygen molecules into atoms, which then gradually penetrate the metal. A study is made of this process and of the diffusion of oxygen atoms through the crystal lattice. The classical diffusion equation is unsuitable; if N_k is the number of atoms in the kth layer at a given time, a differential-difference equation is set up to determine N_k. This is solved and an expression is obtained for the total number of atoms that have penetrated the metal after a given time. L. S. G.

539.234 : 669.75 685

The evaporation of antimony. HARRIS, L. *J. Appl. Phys.*, **17**, 757 (*Sept.*, 1946).

539.26 : 548.73 *see Abstr.* 695

539.26 : 548.73 : 669.18 686

X-ray analysis in the steel industry. WOOD, W. A. *Nature, Lond.*, **158**, 918–19 (*Dec.* 21, 1946).—A report of an Institute of Physics Conference, Nov. 8–9, 1946. The following papers were presented: "The intensity relations of Debye-Scherrer powder diffraction lines," Bradley, A. J.; "The application of X-rays to study of internal stresses and deformation," Wood, W. A.; "An X-ray investigation of electro-deposited chromium," Goldschmidt, H. J.; "Some successes and failures in the application of X-rays to industrial problems," Jay, A. H.; "The surface structure of metals," Finch, G. I.

539.264 687
Amorphous carbon. GIBSON, J., HOLOHAN, M., AND RILEY, H. L. *J. Chem. Soc.*, 456–61 (*June*, 1946).—X-ray diffraction photographs of the so-called "amorphous" carbons have hitherto been interpreted as indicating that they consist of exceedingly minute turbostratic graphite crystallites: this view requires modification in the case of cokes and chars prepared at temperatures below 1 200°. The nature of the organic substance, from which such carbons are prepared, is an important factor in determining their crystallographic character. It has been found possible to prepare carbons which are completely amorphous, i.e. that give no coherent diffraction of X-rays, and indications have been obtained of three-dimensional, covalent cross-linking in such carbons. The bearing of these results on the crystallographic character of cokes and chars is discussed. A.

ELASTICITY . STRENGTH . RHEOLOGY 539.3/.8

539.374 688
A rational formulation of the equations of plastic flow for a Bingham solid. OLDROYD, J. G. *Proc. Camb. Phil. Soc.*, **43**, 100–5 (*Jan.*, 1947).—The equations of plastic flow for a Bingham solid are developed in tensor form. It is then shown that such a solid in a state of flow can be regarded as a fluid with a variable viscosity, which is a scalar function of the stress tensor involving two physical constants, the reciprocal mobility and the yield value of the material. The energy equation is deduced, and the significance of the various terms of this equation is explained. Finally, it is shown that plastic flow of a Bingham solid occurs in such a manner that the rate of dissipation of energy is a minimum. G. O. B.

539.501 : 532.13 *see Abstr.* 539

PHYSICAL CHEMISTRY 541

REACTION KINETICS 541.124/.128

541.127.2 689
On a difficulty in the application of the law of mass action. CHALMERS, J. A., AND GIBBY, C. W. *Phil. Mag.*, **37**, 200–1 (*March*, 1946).

541.128 : 538.222 *see Abstr.* 648

PHOTOCHEMISTRY 541.14

541.141.7 : 539.132 690
Photochemical decomposition of CO. SCHMID, R., AND GERÖ, L. *Proc. Phys. Soc., Lond.*, **58**, 701–4 (*Nov.*, 1946).—The interpretation by Gaydon and Penney of the photochemical decomposition of CO on exposure to Xe radiation at 1 295 Å is criticized. It is pointed out that, with certain assumptions about the dissociation energy of CO, a limiting curve of dissociation to $C(^1S) + O(^3P)$ should lie in this region; absorption is believed to take place in the dissociation continuum corresponding to this process. In the discussion following the paper Gaydon replies to this criticism. A. G. G.

CHEMICAL STRUCTURE 541.4/.6

541.57 : 539.132 *see Abstr.* 656

541.57 : 539.133 *see Abstr.* 662

541.64 : 532.13 *see Abstr.* 540

541.68 : 532.13 691
The viscosities and structures of acid chlorides and amides. FRIEND, J. N., AND HARGREAVES, W. D. *Phil. Mag.*, **37**, 201–6 (*March*, 1946).

541.68 : 532.133 *see Abstr.* 543

CHEMICAL ANALYSIS 543/545

545.38 692
Use of high-frequency oscillators in titrations and analyses. JENSEN, F. W., AND PARRACK, A. L. *Industr. Engng Chem.* (*Analyt. Edit.*), **18**, 595–9 (*Oct.*, 1946).—Energy absorption from high-frequency fields forms the basis of a new method of conductimetric analysis. This method eliminates the use of electrodes, and values may be read directly on a meter. Any changes in ionic or dipole content in ionized or unionized solutions may be followed. The electrical circuit is described, and a variety of types of titrations are presented. A.

545.71 : 534.142 *see Abstr.* 554

CRYSTALLOGRAPHY 548

548.0 : 539.132 : 535.343.2 *see Abstr.* 593

548.24 : 549.514.51 693
A theory of the control of twinning in quartz. WOOSTER, W. A. *Nature, Lond.*, **159**, 94–5 (*Jan.* 18, 1947).

548.54 694
Crystal habit and internal structure. I–II. WELLS, A. F. *Phil. Mag.*, **37**, 184–99 (*March*); 217–36 (*April*, 1946).—I. Some factors influencing the habits of crystals are discussed. Interaction with the solvent is often important. The Gibbs condition for the stability of the crystal is discussed, and evidence is given of a definite equilibrium shape for crystals of a given solute crystallizing from a particular solvent. It is also shown that a macroscopic crystal of non-equilibrium shape shows no tendency to approach this equilibrium shape unless growth is permitted.

The equilibrium shape is a function of the internal structure of the crystal and also of the interactions between the atoms in the faces of the crystal with the solvent. II. The morphologies of anthracene, diamond, zinc blende, rock-salt and fluorite are considered. The crystal habits of some metallic halides are discussed in relation to their crystal structures. L. S. G.

548.73 : 53.081.4 : 537.531 *see Abstr.* 635

548.73 : 539.26 695

Summarized proceedings of conference on X-ray analysis—London, 1946. *J. Sci. Instrum.*, **24**, 1–21 (*Jan.*, 1947).

548.73 : 669.18 : 539.26 *see Abstr.* 686

548.735.46 696

The interpretation of Harker syntheses. BUERGER, M. J. *J. Appl. Phys.*, **17**, 579–95 (*July*, 1946).—A Harker synthesis is a section, perpendicular to a symmetry axis, of the 3-dimensional Patterson synthesis. The position chosen for the plane of section depends on the multiplicity n of the axis. By the transformation given in polar co-ordinates by $r' = r/2 \sin(\pi/n)$, $\phi' = \phi + \pi/2 - \pi/n$, the Harker synthesis is transformed into another for which the name *implication diagram* is proposed. In 5 space-groups the implication diagram is a true map of the crystal structure. In the rest it is a true map plus complications called *ambiguities* and *satellitic peaks*; the latter can be recognized and ignored but it is generally impossible to remove the former. Diffuse atoms are likely to be lost in the background. It is possible to determine the space-group except for the presence or absence of a centre of symmetry, and it is claimed that Harker synthesis realizes the ultimate possibilities of X-ray crystallography. Nine figures and four tables useful in the practical application of the method are given. A. J. C. W.

548.737 697

Crystal structure of copper butyrate monohydrate. IBALL, J. *Nature, Lond.*, **159**, 95–6 (*Jan.* 18, 1947).

MINERALOGY 549

549.211 : 535.343.2 *see Abstr.* 594

549.211 : 535.343.2–15 *see Abstr.* 595

549.211 : 535.343.2–31 *see Abstr.* 596

549.211 : 535.375.5 *see Abstr.* 601

549.514.51 : 548.24 *see Abstr.* 693

GEOPHYSICS 55

550.341 : 534.213 698

Earth movement resulting from an atomic bomb explosion. *Nature, Lond.*, **159**, 85–6 (*Jan.* 18, 1947).—A short account is given of seismograph records taken on the occasion of the explosion of the first atomic bomb at Los Alamos, July 16, 1945.

550.381 : 538.71 : 622.1 : 621.317.44 = 397 699

New magnetometric methods. ISING, G. *Tekn. Tidskr.*, **76**, 1299–306 (*Dec.* 14, 1946) *In Swedish.*—[Abstr. 692 B (1947)].

550.83 700

Geophysical prospecting and English oilfields. *Nature, Lond.*, **158**, 931–4 (*Dec.* 28, 1946).

550.93 701

A revised estimate of the age of the earth. HOLMES, A. *Nature, Lond.*, **159**, 127–8 (*Jan.* 25, 1947).—[See Abstr. 1983 (1946)]. The revised value is 3 350 million years.

METEOROLOGY 551.5

551.508.11 : 621.396.91 702

Ultra-high-frequency radiosonde direction finding. YUAN, L. C.-L. *Proc. Inst. Radio Engrs, N.Y. Wav. Electrons*, **34**, 852–7 (*Nov.*, 1946).—[Abstr. 805 B (1947)].

551.510.535 : 621.396.11(941) 703

Sporadic *E*-region ionization at Watheroo Magnetic Observatory, 1938–1944. WELLS, H. W. *Proc. Inst. Radio Engrs, N.Y. Wav. Electrons*, **34**, 950–5 (*Dec.*, 1946).

551.510.535 : 621.396.812 = 82 704

Results of ionosphere investigations during solar eclipse on 9th July, 1945. KASANTSEV, A. N. *Bull. Acad. Sci., URSS, Sér. Phys.*, **10** (*No.* 3) 261–7 (1946) *In Russian.*—[Abstr. 800 B (1947)].

551.594.6 : 621.396.11 705

Measurements of changes of the phase-paths of radio-waves in the ionosphere. FINDLAY, J. W. *Nature, Lond.*, **159**, 58–9 (*Jan.* 11, 1947).—The phase of a reflected echo can be observed by beating with a local oscillator maintained in definite phase relationship with the transmitted pulse, and following the resultant beat oscillation on a c.r.o. Continuous photographic records were taken of variations of phase path as small as 100 m. The phenomena attending Dellinger fade-outs are described, and the behaviour of "quiet" and "disturbed" *E*-layers. An estimate is made of the collisional frequency of electrons with neutral atoms in the fade-out region.

551.594.6 : 621.396.11 706

Lateral deviation of radio-waves at sunrise. ROSS, W., AND BRAMLEY, E. N. *Nature, Lond.*, **159**, 132 (*Jan.* 25, 1947).—[Abstr. 774 B (1947)].

551.594.6 : 621.396.11 : 621.396.812 = 82 707

Results of observations on radio wave propagation during solar eclipse on 9th July, 1945. GRIGORIEVA, A. A. *Bull. Acad. Sci., URSS, Sér. Phys.*, **10** (*No.* 3) 253–60 (1946) *In Russian.*—[Abstr. 801 B (1947)].

551.594.6 : 621.396.812 : 621.396.11 = 82 708

Radio observations during the total solar eclipse on 9th July 1945. PAPALEKSI, N. D. *Bull. Acad. Sci., URSS, Sér. Phys.*, **10** (*No.* 3) 237–42 (1946) *In Russian.*—The effects of photon and corpuscular eclipse on ionization of the F_2 and E layers, on the field strength of radio signals and on the change in the angle of reflection from the F_2 layer were ob-

served. The basic role of ultra-violet radiation in the ionization process of all layers in the middle latitudes is confirmed. The max. reduction of ionization density was measured, the bend of F_2 layer during photon eclipse was observed and perturbations in all layers during corpuscular eclipse were recorded. The importance of photon radiation on ionization was proved and relations between absorption coefficient of radio waves and solar radiation were investigated. A. L.

551.594.6 : 621.396.812 : 621.396.6 = 82 709

Radio observations during solar eclipse on 9th July 1945. ALPERT, J. L., AND GOROZHANKIN, B. N. *Bull. Acad. Sci., URSS, Sér. Phys.*, **10** (*No.* 3) 245–51 (1946) *In Russian.*—A detailed description with a circuit diagram of the pulse transmitter and receiver with c.r.t. presentation, time base and time marker is given. The measured reflection distances from the ionosphere are plotted and interpreted. [See Abstr. 708 (1947)]. A. L.

BIOLOGY 57/59

591.185.63 : 591.5 : 525.37 710

Ising's theory of bird orientation. THORPE, W. H., AND WILKINSON, D. H. *Nature, Lond.*, **158**, 903–4 (*Dec.* 21, 1946).—[See Abstr. 2001 (1946)]. Ising's suggestion is criticized on the grounds of the smallness of the response, especially when the semi-circular canals are <1 cm in diameter. Evolutionary theory would indicate outstanding development of the canals in migratory birds compared to animals, and in small birds compared to large, but a table shows no such evidence.

591.5 : 525.37 : 591.185.63 *see Abstr.* 710

MEDICAL SCIENCE . HUMAN PHYSIOLOGY 61

612.014.421.7 : 621.314.3 711

Electroencephalographic technique from an engineer's point of view. EGAN, W. G. *Proc. Inst. Radio Engrs, N.Y. Wav. Electrons*, **34**, 1000–4 (*Dec.*, 1946).—High-gain, high-fidelity amplifying equipment is used to record 50 μV, 2–40 c/s impulses from the brain. A brief summary of interpretation is made, particularly in reference to artifact. A new type of electrode is described which fulfils the criteria for good leads. Suggestions are made for the improvement of calibration accuracy and recorder performance. A.

666.115 : 539.213.1 *see Abstr.* 682

669.18 : 535.247 : 778.3 : 536.521 *see Abstr.* 615

669.75 : 539.234 *see Abstr.* 685

PHOTOGRAPHY 77

771.36 : 621.317.39 712

Instrument for investigating the operation of camera shutters. DIGHTON, D. R., AND ROSS, H. M. *Photogr. J.*, **86 B**, 110–16 (*Sept.-Oct.*, 1946).—A characteristic curve of the shutter is portrayed on the screen of a cathode ray tube. No synchronization is needed between the shutter and instrument, the traverse of the fluorescent spot starting immediately the shutter blades begin to open. After the curve has been drawn, the spot makes a second traverse, closing in the base line of the pattern and adding vertical timing marks at 1/10, 1/100 or 1/1 000 sec intervals. The curve remains visible for several seconds, and automatic brightness control maintains an even brightness at all parts of the curve. A miniature discharge flash-tube has been built into the instrument, and may be flashed at any point in the operating cycle of the shutter, for inspecting the shutter and its mechanism during operation. A.

778.3 : 535.247 : 669.18 : 536.521 *see Abstr.* 615